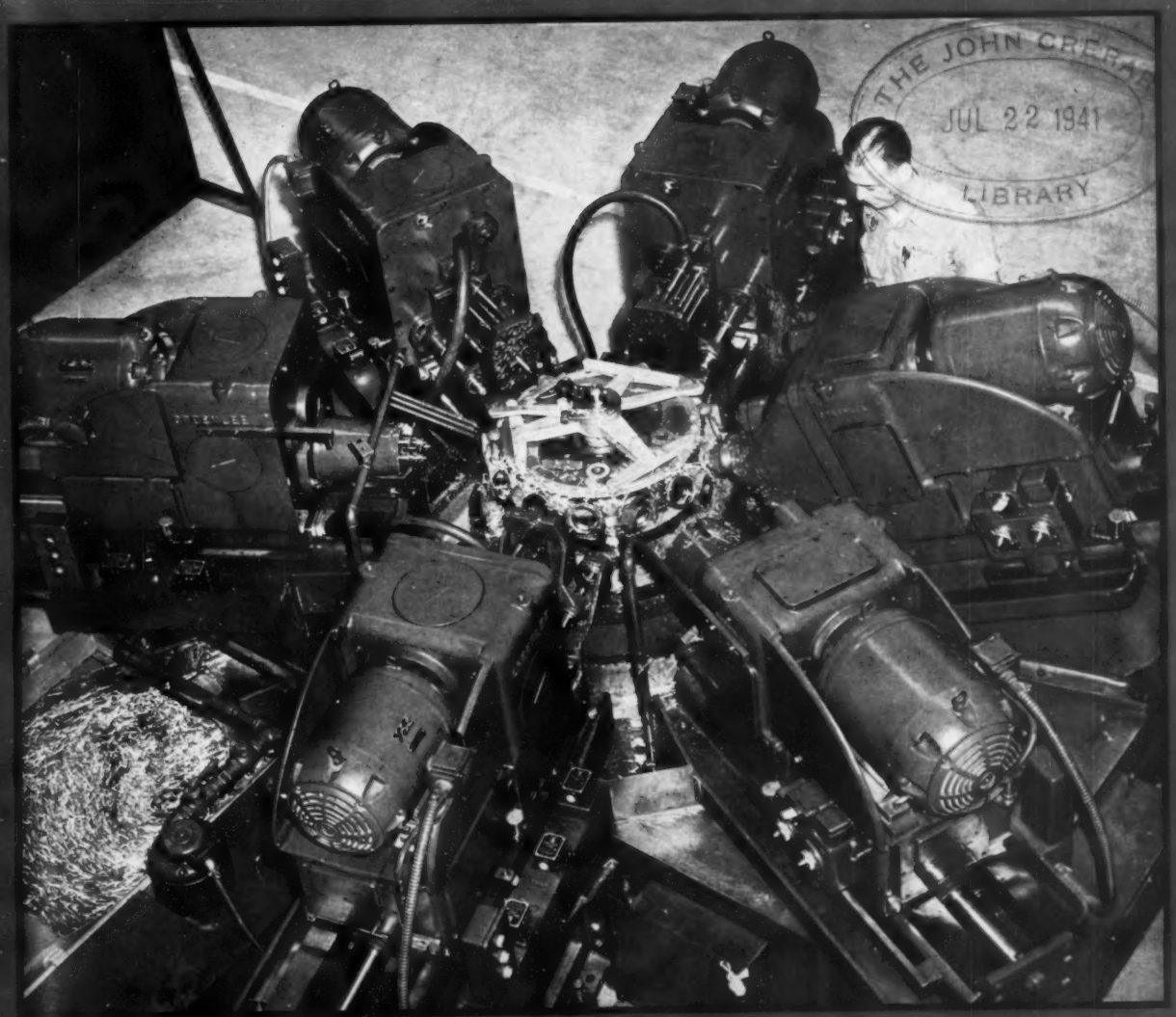
JOURNAL OF THE AERONAUTICAL SCIENCES

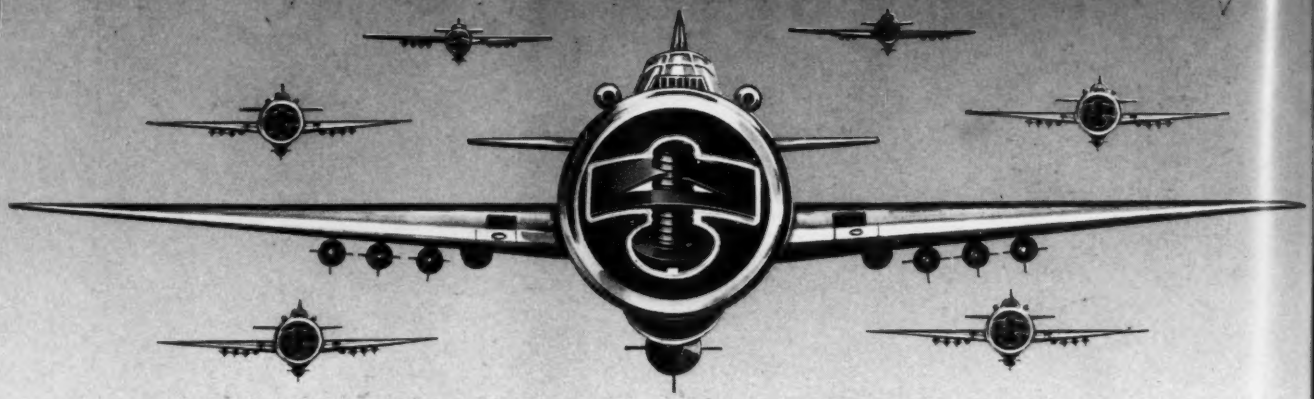
AERONAUTICAL REVIEW SECTION



THE JOHN CRERAR
JUL 22 1941
LIBRARY

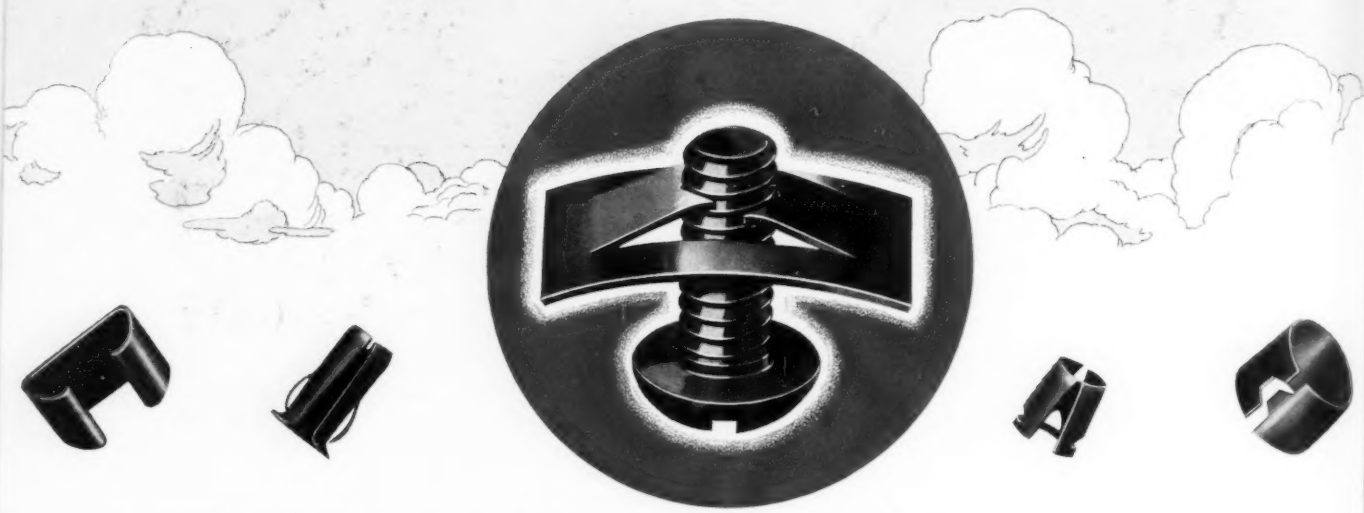
VOLUME 8 JULY, 1941 NUMBER 9

SQUADRON LEADER *of the* ASSEMBLY LINE



Speed Nut System

(PATENTED)



The SPEED NUT is the squadron leader because it is setting a new pace. It out-performs conventional fastening devices. It does more, with less weight, and does it faster. It stops vibration loosening, cuts costs and breaks all previous speed records.

SPEED NUTS and Speed Clips are manufactured in over 700 shapes and sizes to hold bolts, screws, rivets and studs. Made for metal, wood, ceramic or plastic applications. In thousands of cases throughout mass production industries, the SPEED NUT has answered the call for a finer, faster assembly at about half the total net cost.

Simply send us your assembly details and we will furnish samples and engineering data promptly.

TINNERMAN PRODUCTS, INC., 2079 FULTON ROAD, CLEVELAND, OHIO

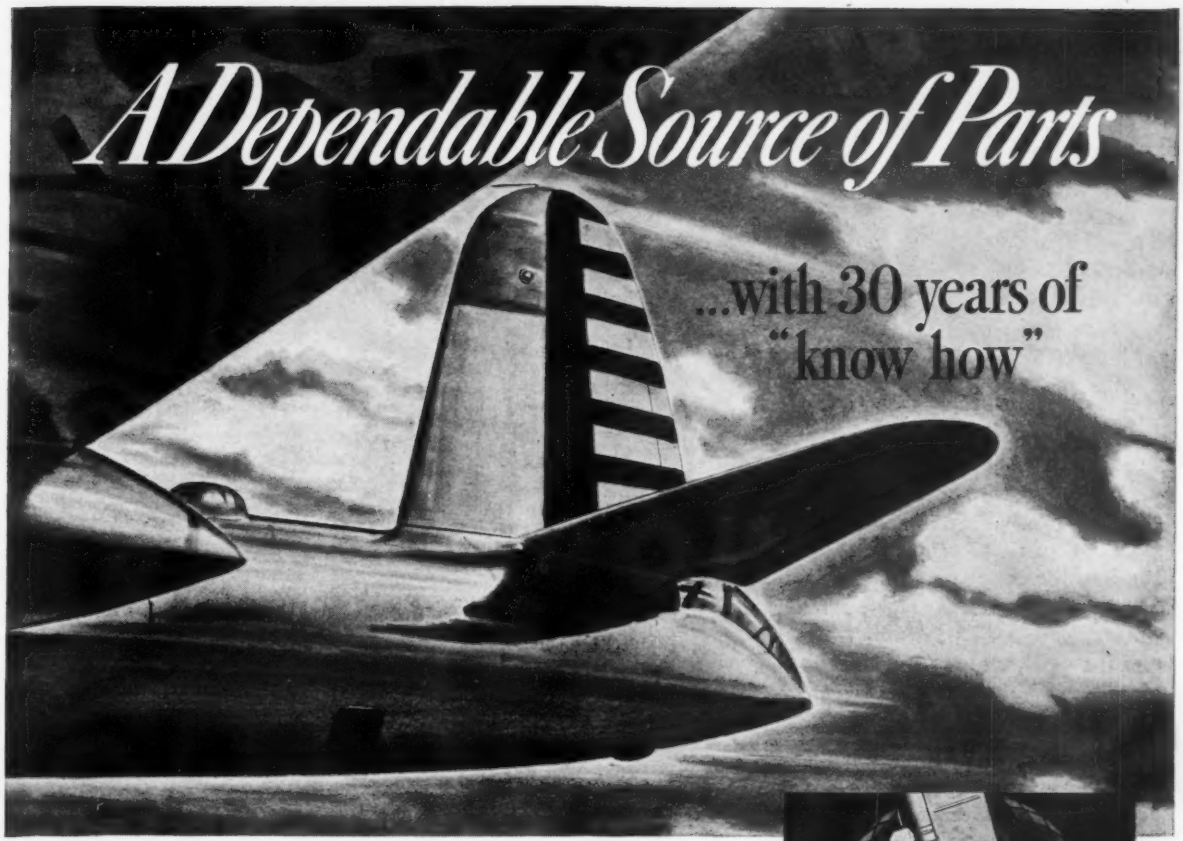
Manufacturers of Patented SPEED NUTS

IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario IN ENGLAND: Simmonds Aerocessories, Ltd., London IN FRANCE: Aerocessoires Simmonds, S. A., Paris

OVER A BILLION IN USE—OVER 700 SHAPES AND SIZES

A Dependable Source of Parts

...with 30 years of "know how"



B-26 bomber tail surfaces, built on subcontract by Goodyear Aircraft Corporation

TO help meet the nation's need for planes and still more planes, Goodyear is serving the aviation industry with all the skills acquired in our thirty years' experience in aeronautical engineering.

Today, through our subsidiary Goodyear Aircraft Corporation, we are manufacturing numerous essential parts that come within our wide knowledge of light metal alloy fabrication for aircraft construction.

These parts include wings, nacelles, floats, tail and other surfaces, now being produced on subcontract for primary airplane manufacturers, including The Glenn L. Martin Company, Consolidated Aircraft Corporation, Curtiss-Wright Corporation and Grumman Aircraft Engineering Corporation.

At the same time our output of airplane tires, tubes, wheels, brakes and other airplane accessories is at its all-time high, and increasing every day.

This, with our production of bullet-puncture-sealing rubber linings for gas and oil tanks, flotation bags, quick inflatable rubber boats and other life-saving equipment, makes Goodyear the nation's foremost supplier in this field.

By this "all out" cooperation with the aviation industry, Goodyear is pursuing the same forward-looking policy it has long maintained with automobile and motor truck manufacturers – namely, to serve as a mass-producer of quality parts developed out of our close association with all transport problems.

Goodyear airplane tires, tubes, wheels and Hydraulic Disc Brakes, famous for dependability, are built for all types of ships

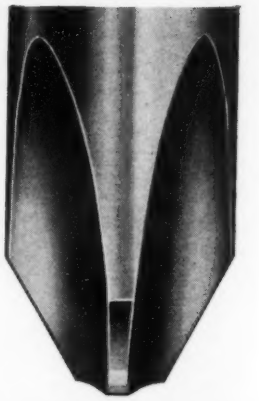
• • •

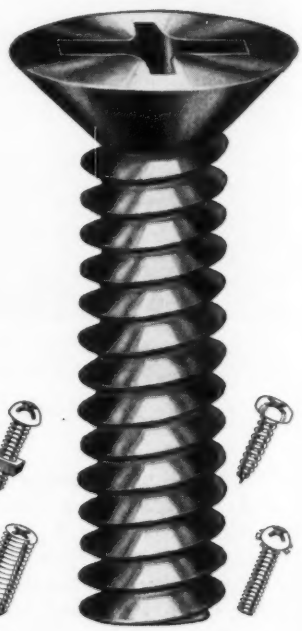
The high quality and dependability of Goodyear products is attested by their universal use on all types of aircraft.

GOODYEAR

ON YOUR NEW SHIP SPECIFY GOODYEAR
AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

HOLTITE-Phillips RECESSED HEAD SCREWS & BOLTS *break* *Production Bottlenecks*



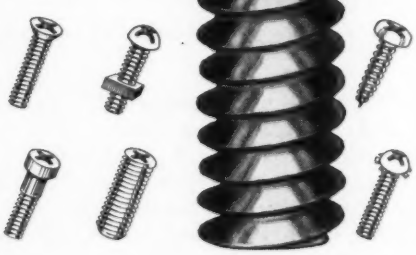


Manufacturers report cutting their assembly time up to 50% by using HOLTITE-Phillips fastenings which permit faster driving methods, reduce spoilage and injuries, and increase holding power. Specify HOLTITE-Phillips for faster production and greater economy.

Since 1910 Continental Screw Co. has been experimenting, tooling, analyzing wire and developing special equipment for producing special parts and fastenings with upset or recessed heads.

Of particular interest to the aircraft industry is our ability to make nickel alloy steel screws. With modern laboratory facilities, skillful engineering staff and precision machinery, our nickel alloy screws are made in strict accordance with specifications.

HOLTITE PHILLIPS RECESSED HEAD SCREWS



SPECIALS

We are completely equipped to produce any type of Special part for fastening of an upset nature—threaded if desired, rolled or cut from most any type of metal. Also second operations including drilling, tapping, slabbing, grooving, threading, slotting, forming, etc., with every facility for completing the piece. Send samples or specifications of your requirements for estimate.

CONTINENTAL SCREW CO

New Bedford, Mass. . . . Warehouses at Detroit & Chattanooga

JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

JULY, 1941

CONTENTS

Cover Illustration—The Greenlee transfer machine, installed at the Wright Aeronautical Corporation's new plant at Cincinnati. It replaces 40 ordinary machines for drilling, counter sinking, reaming and tapping aluminum cylinder heads. The machine will turn out a finished head every two minutes as compared with 35 minutes required by ordinary methods.

Editorial 5

News Review 7

Periodicals 9

Books 31

- Jigs, Tools and Fixtures
- Plastics in Industry
- Thermodynamics
- Prevention of the Failure of Metals Under Repeated Stress
- Airports—1941
- Meteorology
- Outline of Air Transport Practice
- Fluid Mechanics
- Jane's All the World's Aircraft
- The Student Pilot's Training Primer
- Youth in Aviation
- Aircraft Propellers
- Handbook of Welded Steel Tubing
- The Model Plane Annual
- Glossary of Aeronautical Terms
- Aerosphere—1941
- Famous American Flyers
- The ABC of Aviation
- Aircraft Sheet Metal Work
- Physics of the Air
- Analytical Design of High-Speed Internal Combustion Engines
- Pressworking of Metals
- Navigation of Aircraft
- United We Stand!

House Organs and Catalogues 39

From the Industry 43

Engine Cooling Bibliography 49

Directory of Aircraft Products and Services 59

Statements and opinions advanced in Reviews are to be understood as individual expressions and not those of the Institute.

Publication Office: 20th & Northampton Sts., Easton, Pennsylvania
Editorial Office: 1505 RCA Building West, 30 Rockefeller Plaza, New York, N. Y.
Published Monthly by the Institute of the Aeronautical Sciences Inc.

SUBSCRIPTION RATES

Journal of the Aeronautical Sciences including the *Aeronautical Review Section*		Journal of the Aeronautical Sciences *Aeronautical Review Edition Only*	
United States and Possessions	Foreign Countries including Canada (American Currency Rates)	United States and Possessions	Foreign Countries including Canada (American Currency Rates)
1 Year.....$10.00	1 Year.....$12.50	1 Year.....$2.50	1 Year.....$3.00
Single Copies..... 1.00	Single Copies..... 1.25	Single Copies..... .25	Single Copies..... .30

Entered as Second Class Matter at the Post Office, Easton, Pa., May 1, 1937. Acceptance for mailing at a special rate of Postage provided for in the Act of August 24, 1912. Authorized April 29, 1937.

An Appreciation to Corporate Members of the Institute of the Aeronautical Sciences

Listed below are the leading aeronautical and industrial companies who make possible the publication of the *Journal of the Aeronautical Sciences* through Corporate Membership Dues.

The income from these dues enables the Institute to publish scientific and technical papers in the first section of the Journal without advertising and to devote its pages exclusively to editorial material.

The *Aeronautical Review* is devoted to the dissemination of current aeronautical information of a broader scope and is supported by its advertisers and The Paul Kollsman Library Fund. This library lends aeronautical books and sends them by mail, without charge, to aeronautical specialists in any part of the United States.

The above services provide a source of comprehensive technical information for the benefit of the aeronautical profession and industry.

Academy of Aeronautics
Aero Insurance Underwriters
Aircraft Radio Corporation
Aluminum Company of America
American Airlines
The American Rolling Mill Company
Associated Aviation Underwriters
The B. G. Corporation
Bendix Aviation Corporation
  Export Division
  Bendix Products Division
  Eclipse Aviation Division
  Julien P. Friez & Sons Division
  Bendix Radio Corporation
  Pioneer Instrument Division
  Scintilla Magneto Company
Boeing Aircraft Company
Boeing School of Aeronautics
Edward G. Budd Manufacturing Company
The Cleveland Pneumatic Tool Company
Consolidated Aircraft Corporation
Curtiss-Wright Corporation
  St. Louis Airplane Division
  Curtiss Aeroplane Division
  Curtiss-Wright Propeller Division
  Wright Aeronautical Corporation
Douglas Aircraft Company
  El Segundo Division
Eaton Manufacturing Company
Edo Aircraft Corporation
Engineering and Research Corporation
Ethyl Gasoline Corporation
Fairchild Aviation Corporation
  Fairchild Aerial Camera Corporation
  Fairchild Aerial Surveys
Fairchild Engine & Airplane Corp.
  Duramold Aircraft Corporation
  Fairchild Aircraft Division
  Ranger Aircraft Engines Division
Fleetwings, Inc.
General Tire & Rubber Company
The B. F. Goodrich Company
Goodyear Tire & Rubber Company
Grumman Aircraft Engineering Corp.
W. & L. E. Gurley
The International Nickel Company
Casey Jones School of Aeronautics
Kollsman Instrument Division, The Square D Company
Lockheed Aircraft Corporation
  Vega Airplane Company
Glenn L. Martin Company
Norma-Hoffmann Bearings Corporation
North American Aviation, Inc.
Northrop Aircraft Inc.
Northwest Airlines, Inc.
Packard Motor Car Company
Pan American Airways
Pump Engineering Service Corporation
  Division, Borg-Warner Company
The Pure Oil Company
RCA Manufacturing Company
Shell Oil Company
Socony-Vacuum Oil Company
Sperry Gyroscope Company
Standard Oil Company of California
Standard Oil Company (Indiana)
Standard Oil Company of New Jersey
Summerill Tubing Company
The Texas Company
Thompson Products
Transcontinental & Western Air, Inc.
United Aircraft Corporation
  Hamilton Standard Propellers
  Pratt & Whitney Aircraft
  Vought-Sikorsky Aircraft Division
United Air Lines Transport Corporation
United States Aviation Underwriters
Vultee Aircraft, Inc.
  Nashville Division
  Stinson Aircraft Division
Westinghouse Electric and Mfg. Company
Wyman-Gordon Company

Lester D. Gardner
Editor
William H. Graham
Ward Seeley
Associate Editors
William S. Friedman
News Editor

AERONAUTICAL REVIEW

George R. Forman
Managing Editor
Robert R. Dexter
Technical Editor
Bennett H. Horchler
Manager

Then and Now

COMPARISONS BETWEEN THE SPEED, range and size of the first Wright model and the type of airplane now in use are not nearly as significant as the expansion of factory areas.

In a small building of a few thousand square feet, the early Wright machines were built. There were no large factories to provide engines, propellers and instruments. All were made and assembled under a single roof. In one corner was the machine shop for making metal parts for the engine and airplane. In another, the woodworking was done by a few workmen. At a bench, propellers were shaped. Probably the first woman employed in the aircraft industry sat at a sewing machine preparing the covering for the wings.

From these small beginnings, an industry which occupies millions of square feet of buildings and will employ a half million men has, in a quarter of a century, become one of the leading factors in the manufacturing activity of the United States.

The Wright Brothers are so acclaimed for their success in giving to the world its first practical airplane and teaching their followers to fly that seldom are they credited with the founding of a great industry which has unlimited possibilities.

If they could have foreseen what changes their work was to bring, they would have undoubtedly received a greater satisfaction from the social changes that the airplane has brought and the vast employment of skilled and unskilled labor that has resulted from the first product of their small factory.

Simplicity Maketh for Understanding

The events which have put aviation on the front line of defense and brought thousands of new people and millions of square feet of plant space into the American and British aviation picture have incurred a multitude of educational problems.

Typical of the rôle undertaken by the aeronautical press in helping to assimilate these new people is the *Glossary of Aeronautical Terms* by the English author, Douglas H. Nelson, reviewed in this issue. The compiler has taken the nomenclature adopted by the British Standards Institute and explained it in terms understandable to the newly acquired factory workers such as women riveters and former coopers and cabinet makers.

In ordinary times, a volume like this would probably be filed on the reference shelf and relegated to the use of apprentices and fledglings. Now times are different. Events have shaped the pattern of aircraft manufacture in such a manner that parts of airplanes are being built by men who formerly worked on products as unrelated to aircraft as ice boxes and roller skates.

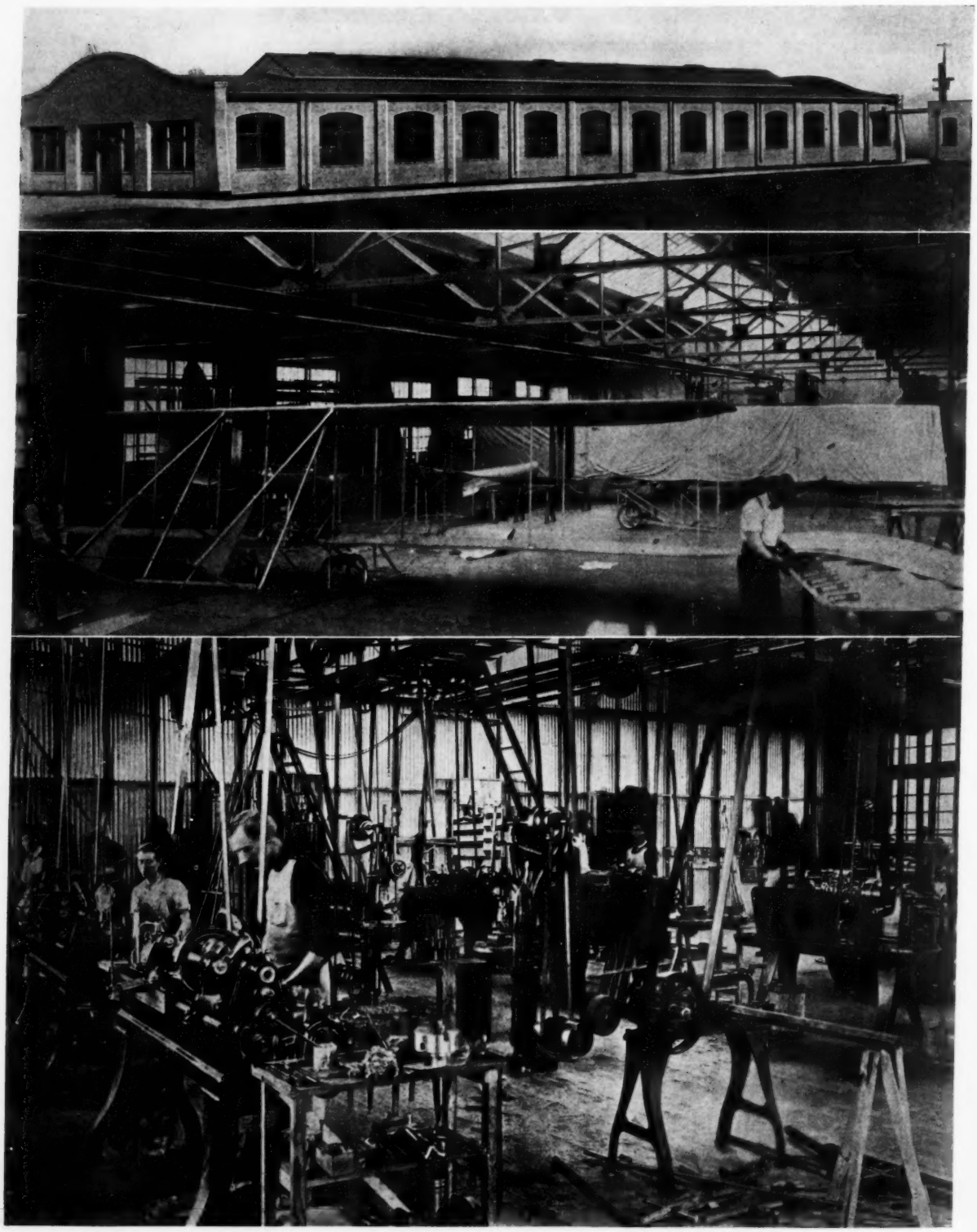
Getting background information to these new people requires an entirely new technique in published technical information and particularly the simplification of the language in which it is delivered. Nelson's book does this for the British worker. He has limited the glossary to a few hundred terms, eliminating vague and redundant usages.

This work is an invitation for authors and magazine writers to create technical works in simplified aeronautical language for the benefit of this group, so that they in turn may benefit the industry by being absorbed without undue loss of time.

Toward a Planned Future

One important result of the ever expanding aircraft program will be the great stimulus to engineering education. Although technical training has grown in popularity with remarkable acceleration since the turn of the century, the present demand for engineers for aircraft work has attracted thousands of young men to study aeronautical engineering. The need has been so great and the field so wide that great numbers of these men have taken short cuts to employment by specializing in certain limited fields which do not require the broad educational fundamentals of complete engineering training.

No greater problem confronts the aircraft industry than long-range planning to keep these young specialists employed after the present emergency. Labor can be shifted from one industry to another with comparative ease, but the absorption of engineering talent presents greater difficulties. No better investment of some of the earnings which will come from huge backlogs of orders can be made than the setting-up of planning groups which will have as their chief aim a continuity of employment for engineers now engaged in aircraft production.



The First Aircraft Factory in the United States.
The Wright Company, Dayton.

News Review

May 11. Trans-Canada Airlines began service between Toronto and New York.

May 13. C.A.A. figures on airline traffic for the first quarter of 1941 indicated increases of 26 per cent in airplane miles, 35 per cent in passenger miles flown and 42 per cent in air express deliveries over the same period last year.

May 14. The War Department announced creation of a Maintenance Command for the Air Corps. Col. H. J. F. Miller was designated as chief, with headquarters at Patterson Field, Dayton, Ohio. Four Maintenance Wings, one for each air force, will serve under his command with the Transport Wing incorporated as a section of each unit.

May 15. Twenty-one Boeing B-17D four-engined bombers were flown 2,400 miles from Hamilton Field, California to Hickam Field, Hawaii, to bolster Pacific air strength. The flight required 13 hours, 59 minutes.

May 15. Senate Banking Committee approved legislation permitting the Reconstruction Finance Corporation to set up and operate plants to manufacture defense materials not produced by private companies. The bill would also enable the R.F.C. to take over South and Central American bases acquired by Pan American Airways and to operate government-directed airlines in the Western Hemisphere in competition with those operated by German and Italian companies.

May 17. Plan for training several thousand British fliers in the United States was approved by the War Department. The plan, which went into operation in June, arranged for the men to receive primary training at civilian flying schools and advanced work at Army training centers.

May 17. The Bristol, first of three Boeing clipper-type flying boats recently acquired by British Overseas Airways from the Pan American Airways System, was placed in service at LaGuardia Field, New York.

May 17. Dr. Edward Ray Wedlein, chief of the chemical and allied production section of the Office of Production Management, urged construction of underground storage tanks for aviation gasoline and fuel oil along the Atlantic Seaboard.

May 17. The first of a new type 20-mm. aircraft cannon to be produced in the U.S. was turned over to the Army by Eclipse Machine Division of the Bendix Aviation Corp. at Elmira, N. Y.

May 20. The Nash-Kelvinator Corporation at Detroit announced that it would immediately undertake the manufacture of Hamilton Standard propellers at a Reo Motor Car Co. unit which the government had acquired for that purpose at Lansing, Mich.

June 12. Orville Wright, the first man to fly an engine-driven heavier-than-air craft, inspects the Greenlee transfer machine at the dedication of the Wright Aeronautical Corporation's 50-acre plant at Cincinnati. Guy W. Vaughan, president of Curtiss-Wright is on Mr. Wright's left. On his right are Myron B. Gordon, vice-president and general manager of the Wright organization and Co-director William S. Knudsen of the Office of Production Management.

May 20. Examinations for prospective candidates for the Army Air Corps were ordered by Secretary of War Henry L. Stimson to be made less severe. Starting August 12, requirements for those seeking to become flying cadets will be reduced from two years of college or an alternative of examination in nine subjects, to examinations in five required and two optional subjects.

May 22. T.W.A. announced the "Constellation," a transport airplane powered by four 2,500 hp. motors. The airplane, to be completed by Lockheed Aircraft Corp. next year, is designed to carry 64 passengers or 100 armed soldiers at a top speed of 350 m.p.h. It was developed by Howard Hughes and Jack Frye.

May 23. That airline operations at Newark Airport would be resumed was made public in an announcement by American Airlines, T.W.A., United Air Lines and Eastern Air Lines. Seventy schedules a day will be run out of the airport.

May 23. Patents for a single-bladed autogiro were applied for by the estate of the late Juan de la Cierva. The new system, according to the application, would reduce rotor vibration in starting and in forward flight.

May 25. The U.S. Navy took over Floyd Bennett Airport, N. Y. It is now known as U.S. Naval Station, New York.

May 28. The House Military Affairs Committee ordered creation of a subcommittee to investigate the possibility of gliders as military aircraft.

May 28. The Air Corps announced completion of eight of its 100 projected flying schools and partial occupancy of another fifty. The program, when completed, is to provide

(Continued on page 42)

The Paul Kollsman Library

of the

Institute of the Aeronautical Sciences

A lending library service of the Institute which makes available, without charge, the latest and more important aeronautical books to members of the Institute and others interested in aeronautical progress.

Membership in the library is open to all members of the Institute of the Aeronautical Sciences and to any person in the United States over 18 years of age who can furnish references which certify as to his responsibility and reliability.

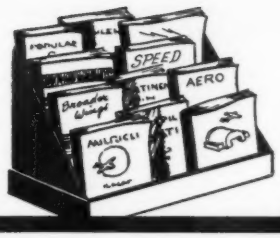
The Aeronautical Reader's Guide

A catalogue of selected aeronautical books available for loan from The Paul Kollsman Library. The Guide lists and comments on books and by indexing them under specialized headings also acts as a valuable reference source for aeronautical specialists, companies, libraries and other organizations.

The Guide is issued quarterly in September, December, March and June, and is priced at $1 for the four issues in each volume. Single copies are not available and subscriptions may only be accepted for complete volumes.

Further information will be sent on request.

THE PAUL KOLLSMAN LIBRARY
1505 RCA BUILDING WEST
30 ROCKEFELLER PLAZA, NEW YORK, N. Y.



Periodicals

Aerodynamics

The Flow of a Perfect Fluid Through Cascades of Aerofoils. A. R. Collar. The results of a research study conducted in the Aerodynamics Department of the National Physical Laboratory (British) are published in this paper. The report contains a generalization of the conformal transformation by means of which a circle is converted into Joukowski airfoils. The transformation is applied to a cascade of oval bodies which is the corresponding generalization of the isolated circle. It converts the oval bodies into a wide variety of cascades of curved shapes, which are generalizations of the isolated Joukowski airfoils.

In one particular case, the transformation yields a grid of flat laminae. Since the perfect fluid flow through such a grid is known (it appears to have been first given by Joukowski), the perfect fluid flow past the ovals, in any direction, and with equal but otherwise arbitrary circulation round each, is obtained. Accordingly, the perfect fluid flow through any of the derived cascades can be obtained. *Journal of the Royal Aeronautical Society*, May 1941, pages 183–213, 24 illus.

Sechskomponentenmessung an einem Seeflugzeugmodell (Six Component Scale Measurements of a Seaplane Model). O. Pabst. In order to supplement test data on the reaction of seaplanes in an airflow of any direction, this report of the Focke-Wulf Flugzeugbau presents an investigation on a seaplane of the Focke-Wulf type.

This study differs from previous reports as the test was made without a smooth water surface. Previous tests were based on stability problems of seaplanes floating on water, while the present case considers first of all static problems. Measurements were made in a lateral airflow at angles of incidence from 0° to 360° and at angles of attack from 0° to 30°. The results are discussed and compared with previous published data on the subject. *Luftfahrtforschung*, March 1941, pages 47–51, 12 illus.

Beobachtung des Einflusses von Flügelanbauten und Klappen auf den Abreissverlauf der Tragflügelströmung (Observation of the Effect of Additional Structural Units of the Wing and of Flaps on the Progress of Tearing of the Flow on a Wing). G. Hartwig. The dependence of the progress of the tearing of flow around a wing on the profile and warping of the wing has often been investigated experimentally. However, very little has been published on the tearing phenomenon when there are additional structural units such as fuselage and nacelles or when there are deflected landing flaps over an area of the conventional span.

During the development of the Focke-Wulf Fw 200 (Condor), wind tunnel tests were made to investigate the tearing process on several wings of the same aspect ratio, but with a different stress-carrying line; also on the wing with additional fuselage, nacelles and deflected landing flaps. The results are presented in this report of the Focke-Wulf Flugzeugbau. *Luftfahrtforschung*, March 1941, pages 40–46, 26 illus.

Zur Aerodynamik des Flugzeugrumpfes (On the Aerodynamics of the Fuselage of an Airplane). H. Multhopp. This report of the Focke-Wulf Flugzeugbau gives formulas to determine the share the fuselage and engine nacelles contribute to the total aerodynamic forces acting on an airplane at a series of technically important flight attitudes.

Special attention is given to phenomena due to the interaction of fuselage and other airplane parts, especially wings. For the calculation of load distribution across the wing and the fuselage, a simplified method is developed. By means of a very simple conformal representation, a wing which is equivalent to the fuselage-wing combination may be determined with this calculation. A conventional calculation must be made for the lift distribution on this wing.

Load distribution along the length of the fuselage and the corresponding displacement of the neutral point by the fuselage are approximately realized by means of a simple impulse estimation. On a slipping airplane, due to the displacement flow around the fuselage, an asymmetric additional lift distribution along the wing takes

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Review or the Institute of the Aeronautical Sciences.

Index

Aerodynamics	9
Air Cargo	10
Airplane Descriptions	11
Air Policy	12
Airports	13
Air Transport	13
Avigation	14
Business and Finance	14
Civil Air Defense	14
Design	14
Engines	15
Fuels and Lubricants	17
Gliding and Soaring	17
High Altitude Flying	17
History	17
Instruction	18
Instruments	18
Instrument Flying	19
Materials	19
Medicine	19
Metallurgy	19
Meteorology	20
Military Aviation	21
National Defense	21
Naval Aviation	22
Parachutes	22
Personalities	22
Production	23
Propellers	26
Rotating Wing Aircraft	27
Stress Analysis	27
Testing Equipment	28
Tools and Equipment	28
Warfare	29
Welding	29
Miscellaneous	30

place, causing quite a considerable rolling movement due to side slip. Furthermore, a lateral wind is created on the vertical tail surfaces and has a considerable effect on directional stability and on banking. The order of the magnitude of these phenomena is estimated. *Luftfahrtforschung*, March 1941, pages 52–66, 18 illus.

Einfluss der Machschen Zahl auf den Wirkungsgrad von Luftschrauben (Effect of the Mach Number on the Efficiency of Propellers). H. Wolff. The effect of the Mach number on the efficiency of propellers with high tip speeds is evident at increasing flying speeds. This effect is being investigated on the Focke-Wulf type Fw 200 (Condor). According to Weinig's proposal, this effect is fixed by the efficiency η_u. Start and progress of the effect at increasing Mach numbers are determined and compared with the range of influence specified by Weinig. *Luftfahrtforschung*, March 1941, pages 67–69, 6 illus.

Sinkgeschwindigkeit nach Abfangen (Rate of Descent After Righting). J. Cassens and H. Schaefer. A special study of the speed conditions during the landing of an airplane. The equations of motion, which have been set up under certain simplifying assumptions, are integrated and lead to an approximate formula for the magnitude of the vertical rate of descent. The importance of these calculations for the conception of rate of descent is discussed before examination of the theoretical phase of the subject. *Luftfahrtforschung*, March 1941, pages 77–81, 13 illus.

Some Experimental Results on Wing Flutter. William Bollay and Charles D. Brown. This paper represents a progress report of some experiments being carried out in the aerodynamics laboratory of Harvard University.

The first part of the investigation consisted in the measurement of the vibration response curves of a wing in the wind tunnel. A wing, free to vibrate in bending and in torsion, was subjected to a forced vibration at various air speeds up to the flutter speed. These measurements show how the two natural frequencies of the wing come together as the flutter velocity is approached. The peaks of these response curves determine the maximum stresses which are experienced, for instance, by a propeller which is subjected to periodic impulses from the engine.

The second part of the investigation deals with the problem of flutter above the stall. Measurements show that at angles of attack above the positive stalling angle and below the negative stalling angle the flutter speed is decreased to less than one-third of the flutter speed of the unstalled wing. This flutter seems to be associated with an instability which arises when the slope of the lift curve becomes negative. Experiments on a metal wing supported as a cantilever indicate that the flutter at the stall may also be associated with an excitation from a system of Kármán vortices. *Journal of the Aeronautical Sciences*, June 1941, pages 313–318, 13 illus.

The Effect of Design Variables on Cargo Plane Performance. Adolph Burstein. The possible development of an air freight system in the United States brings up the relationship of aerodynamic design to the economical operation of cargo airplanes. It is shown that a careful analysis, in the light of operating costs and safety, of all factors entering the design of an airplane is essential, if a sound design is to be evolved.

A method of evaluating the major design variables is presented. It is also shown that the operation of the airplane and the degree of safety desired must be decided upon before proceeding with a design.

The broad scope of the investigation suggests that the results presented should be considered qualitatively only. However, definite trends are indicated. No fundamental aerodynamic difference exists between a well-designed cargo airplane and a passenger airplane. *Journal of the Aeronautical Sciences*. June 1941, pages 325–330, 8 illus.

On the Subsonic Flow of a Compressible Fluid Past a Symmetrical Joukowski Aerofoil. Susumu Tomotika and Hazimu Umemoto. The report of a reinvestigation of the two-dimensional irrotational subsonic flow of a compressible fluid past a symmetrical Joukowski airfoil placed at an arbitrary inclination to the direction of the undisturbed stream.

Special attention was given to study of the manner in which the value of the so-called critical Mach number for the symmetrical Joukowski airfoil varies with the angle of attack as well as with the thickness ratio of the airfoil. Results and findings are summarized in detail. *Report of the Aeronautical Research Institute, Tokyo Imperial University*, No. 205, March 1941, pages 1–125, 13 illus.

Über den Einfluss der Düse (oder des Auffangtrichters) auf Widerstandsmessungen im Freistrahl (On the Effect of the Bell [or the Bell Mouth] of a Wind Tunnel on Resistance Measurements in a Free Jet). Dietrich Kuchemann and Friedrich Vandrey. Calculation of the three-dimensional potential flow around half-bodies and sources and sink-bodies in a wind tunnel with a circular section.

This wind tunnel consists partly of solid walls (bell mouth) and partly of a free jet. In order to realize marginal conditions, source rings are arranged on the solid wall and vortex rings on the jet limit. The integral equation for this arrangement may be solved numerically by iteration.

Additional speeds necessary for the eventual correction of this measured resistance, coefficients and additional resistance due to the effect of the bell are determined from the arrangement. In all important cases this additional resistance is below the accuracy of measurement, while the field of speed in the proximity of the body is often noticeably disturbed by the wind tunnel walls and the free jet limits. *Z.A.M.M.*, February 1941, pages 17–31, 12 illus.

Statistische Schätzungen auf kombinatorischer Grundlage (Statistical Estimates on a Combinational Principle). Hermann von Schelling. With the assistance of a uniform, purely combinational method it is possible to judge the safety of the arithmetical mean value of n observations of a constant magnitude and to secure an estimate of the difference between two such mean values.

Through specialization, the reliability of the observed frequency of an alternative characteristic may be estimated and the difference between two such frequencies may be investigated. This study is partly an important generalization and partly an essential correction of the former conventional formulas. *Z.A.M.M.*, February 1941, pages 52–58.

Air Cargo

Tomorrow's Freighters. When the present military emergency is over, vast expansion of air freight service is expected to take place. To meet this, The Glenn L. Martin Company has planned the production of a freighter with a capacity of 85 tons and a range of 3,500 miles. *Popular Science*, June 1941, pages 54, 55, 1 illus.

Sky Cargoes. Charles Morrow Wilson. Information is presented on the growth and expansion of air express in the United States and abroad. Some of the unique commodities shipped in the freight compartments of transport aircraft are noted. According to this report, air freight is heaviest in those sections lacking rail facilities, but overcrowded roads and freight trains are diverting onto the airways an increasing amount of express needed for fast delivery. *Popular Science*, June 1941, pages 49–53, 9 illus.

Airplane Descriptions

Some Details of the Bell "Airacobra" Interceptor. Notes on certain design features and characteristics of the Bell P-39, particularly in respect to armament and fire power. Cutaway sketch shows arrangement in fuselage and wings. Specification figures are listed. *Aero Digest*, June 1941, pages 142, 209, 3 illus.

The Meyers Trainer. Description of the Meyers OTW combination primary and advanced trainer. A two-place open biplane powered by a 125 hp. Warner engine, it has an all-metal fuselage of semi-monocoque structure to the rear cockpit and full monocoque aft of that station. The wings are of conventional wood structure, fabric covered. Over-all dimensions and performance figures are provided in the article. *Aviation*, June 1941, page 97, 3 illus.

The Caproni Bergamaschi Ghibli Colonial Monoplane. This low-wing twin-engined general purpose monoplane is powered by two 200 hp. Alfa-Romeo A-114 inverted six-cylinder air-cooled engines. The airplane has a welded steel-tube fuselage and wooden wings, and is entirely fabric covered. Top speed is 158 m.p.h.; service ceiling, 14,760 ft. *The Aeroplane*, April 25, 1941, page 468, 5 illus.

Naval Aircraft. Descriptions of the characteristics, armament and some performance figures of the aircraft being used by the Fleet Air Arm of the R.A.F. The types listed include the Fairey Albacore, Fulmar, Swordfish and Seafox, the Gloster Sea Gladiator, the Blackburn Skua and the Vickers-Armstrong Walrus. *Aeronautics*, May 1941, pages 62, 63, 4 illus.

The Fiat C.R. 32bis Single-Seater Fighter. The Fiat C.R. 32bis, single-place fighter, was Italy's standard combat type throughout the Spanish War. Powered by a 550 hp. Fiat A3OR.A. liquid-cooled 12-cylinder Vee-type engine, this W-strut-braced biplane has a top speed of 230 m.p.h. It is armed with two fixed machine guns firing through the propeller arc. *The Aeroplane*, May 2, 1941, page 494, 5 illus.

Southern Aircraft Corporation's Primary-Secondary Trainer. Southern Aircraft's BM-10 biplane trainer incorporates design features intended to facilitate production and to simplify maintenance. It conforms to U.S. Army Air Corps primary trainer specifications covering flight characteristics and structural strength, but is also intended for use as a secondary training airplane. A very full description of the design, material and fabrication features of the airplane is given together with specification and performance figures. *Aero Digest*, June 1941, pages 162, 165, 6 illus.

The Caproni Ca 135 bis Bomber. A slightly altered version of the Ca 135, the newer Caproni twin-engined mid-wing bomber is powered by two Piaggio P.XI R.C.40 18-cylinder two-row radial engines. These power plants replace the liquid-cooled Isotta-Fraschini engines formerly used. The Ca 135 bis still retains the welded steel fuselage faired to an oval section by light wooden stringers. The wings are of conventional wooden structure and the entire airplane is fabric covered. *The Aeroplane*, March 14, 19, 1941, page 308, 5 illus.

The American Fighter. J. I. Waddington. Recalling conclusions drawn regarding American aircraft following a tour of American plants just prior to the present war, the writer says that at that time there was little to choose between the two countries in workmanship or finish—that if there was any balance at all it was in favor of the American product. He recalls that the British "had some way to go to equal American progress in air-cooled engines and commercial aircraft."

The writer finds that these conclusions have been largely confirmed by British experience with American types since the war began. He makes certain general comparisons of corresponding British and American types, and comments briefly on unconventional American fighters, such as the Brewster Buffalo, the Grumman Martlet, the Lockheed P-38, the NA-50 and the Republic Lancer. *Flight*, May 15, 1941, pages 344-b to 344-f, 13 illus.

A New Twin-Engined Fighter. Description of the Focke-Wulf Fw 187. This new twin-engined low-wing monoplane is powered by two Daimler Benz 601A 12-cylinder inverted Vee-type 1,150 hp. liquid-cooled engines. Resembling the lines of the Focke-Wulf Fw 200 Condor, this two-place airplane is heavily armed for use as a bomber escort. The Fw 187 has a wing span of 50 ft. 6 in., a maximum ceiling of 38,700 ft. and a top speed of approximately 360 m.p.h. *Aircraft Engineering*, April 1941, pages 105, 106, 5 illus.

The Meridionali Ro.43 Reconnaissance Seaplane. Description of the Meridionali Ro.43 single-float seaplane, Italy's standard two-place single-engined biplane, designed to be catapulted from cruisers and battleships. Powered by a 700 hp. Piaggio P.XR single-row radial engine, the seaplane has a wingspan of 37 ft. 11 in., a top speed of 185 m.p.h. and a service ceiling of 21,650 ft. *The Aeroplane*, April 11, 1941, page 418, 5 illus.

New British Service Types. Photographs, three-view drawings and brief descriptions of the Curtiss Mohawk (P-36A) single-place fighter and of the Fairey Albacore, a two-place reconnaissance torpedo-bomber for carrier service. *Aircraft Engineering*, April 1941, pages 102, 103, 106, 6 illus.

Zodiac Libra-Det. This low-wing military trainer, powered with a 130 hp. opposed six-cylinder Franklin engine, is built of plasticized plywood in order to avoid delays in material which are in some cases holding up deliveries on all-metal airplanes. This airplane has a wing span of 33 ft., weighs 1,250 lbs. empty and cruises at 107 m.p.h. *Aviation*, June 1941, page 98, 3 illus.

El Cazador Fiat C.R.42 (The Fiat C.R.42 Pursuit Airplane). Description and performance details of the Fiat C.R.42, a single-place pursuit biplane powered by an 840 hp. Fiat A74R.C. 38" engine. The fuselage is of welded alloy-steel tubing, fabric covered, while the wing is of sheet aluminum alloy and extrusion, partly covered in fabric. It is equipped with a three-bladed Hamilton-Fiat, constant-speed propeller. *Aeronautica*, March 1941, pages 8, 9, 2 illus.

The Cant Z.501 Single-Motored Flying Boat. Description of the Cant Z.501, a single-engined parasol-wing flying boat, powered by a 986 hp. 16-cylinder W-type Isotta-Fraschini Asso XI. R2 engine. Used for naval reconnaissance work, the craft carries a crew of five and has three gun emplacements; one in the forward part of the hull, one aft of the wing, and a third in the motor nacelle located in the center-section of the wing. *The Aeroplane*, April 18, 1941, page 442, 5 illus.

Cub Cruiser for Blind Flying. An outline of the characteristics and specifications of Cub Aircraft Corporation's J-5 Cruiser recently introduced in Canada. With one seat forward and two aft, the craft is arranged for passenger flying by removing the rear stick and sliding retractable foot rests over the rudder pedals. Instrument panel and hood are installed to make of the Cub a low-priced blind flying trainer. *Canadian Aviation*, May 1941, page 23, 3 illus.

Aircraft and Engine Review. In its third annual review of Canadian, British and American aircraft, this

magazine includes specifications, pictures and descriptions of some airplanes in regular commercial and military service. Military craft are grouped separately by country. Transport airplanes are treated as a single unit, as are 2–6 place commercial types. The descriptive data on military airplanes are more extensive with fewer gaps than usual in this type of aircraft review. *Commercial Aviation*, May 1941, pages 31–69, 103 illus.

A New Plane to Make Every Man a Pilot. Description of the flight characteristics of the *Skyfarer*, a two-place high-wing monoplane powered with a 75 hp. geared Lycoming engine. The new craft, built by the General Aircraft Corporation of Lowell, Mass., has been placarded by the C.A.A. as characteristically spin-proof.

The Skyfarer was designed by Professor Otto C. Koppen of the Massachusetts Institute of Technology. It is equipped with a tricycle landing gear, two fixed fins (no rudder) and flaps.

Aside from the engine mount and center truss, the entire fuselage is built of aluminum alloy channel. The wing structure is all metal, applying the D-type spar. The entire airplane is fabric covered. Two hours of instruction on the simplified two-directional controls are usually considered sufficient for a competent solo flight. *Aviation*, June 1941, pages 137, 186, 2 illus. Also, *Aero Digest*, June 1941, pages 169, 170, 5 illus.

Une Construction Suisse: L'Avion Léger "E.P.R.301" (A Swiss Design: the Light Airplane "E.P.R.301"). Description of a light single-place sesquiplane of original Swiss design. The craft is powered by a 45 hp. nine-cylinder Salmson engine and is of conventional European lightplane construction—steel tubing and plywood, with fabric covered control surfaces. *Schweizer Aero-Revue*, April 1941, pages 12, 13, 2 illus.

De Britsche Duikbommenwerper "Blackburn Skua" (The British Dive Bomber "Blackburn Skua"). This description of the Blackburn Skua notes its suitability to naval warfare and operation from aboard an airplane carrier. Its characteristics are described as is its 900 hp. Bristol Perseus XII engine. The airplane has a horizontal speed of 375 km.p.h. at full load. Its armament consists of two fixed machine guns in each wing and a mobile machine gun in the second cockpit. *Luchtvaart*, April 22, 1941, pages 144, 145, 2 illus.

Focke-Wulf Fw 189. Description of the Fw 189, a short-range twin-engined reconnaissance airplane. The new type is a low-wing monoplane powered by two 420 hp. Argus inverted Vee-type air-cooled engines. It has two tail-booms, a nacelle in the center, and carries a crew of three. The airplane is armed with two machine guns or light cannon mounted laterally alongside the fuselage, one flexible machine gun on top of the nacelle and one in the rear cone. It has a wingspan of a little over 60 ft., a top speed of 199 m.p.h. and a service ceiling of 27,500 ft. *Interavia*, April 16, 1941, pages 6, 7, 3 illus. Also *The Aeroplane*, May 9, 1941, page 524.

Falco Fighter. A new Italian single-seat fighter which bears a striking resemblance to early models of the Republic fighter, this new craft is a low-wing monoplane powered by a 1,000 hp. Piaggio engine. It has a comparatively low wing-loading for a fighter, only 25.6 lbs. per sq.ft. The Falco has a wingspan of 36.1 ft., a top speed of 332 m.p.h. and a service ceiling of 37,700 ft. *Interavia*, April 3, 1941, pages 8, 9, 1 illus.

Piaggio P.50. Description of the new four-engined long-range bomber built by S. A. Piaggio & Co. The craft is a high-wing monoplane of all-metal construction. It is powered with four 1,000 hp. Piaggio radial air-cooled engines. *Interavia*, April 3, 1941, pages 6, 7, 2 illus.

Interstate Cadet Clinic. Selby Calkins. In order to provide a fresh viewpoint on airplane performance, the writer, a pilot himself, flew as a student with Cecil E. Smallwood, California instructor, to observe his reactions to the structure and flight characteristics of the Interstate Cadet. A tandem high-wing monoplane, the Cadet was designed primarily as a trainer. The writer found the airplane to have excellent flying characteristics. Minor suggestions are offered for making the craft easier for students to fly. *Western Flying*, June 1941, pages 28–30, 47, 4 illus.

No Ersatz. Ernest Bruce. A more detailed examination of the Messerschmitt 110 twin-engined light attack bomber. On April 1, a specimen of this type, forced down in England, had been shipped to Vultee Aircraft Inc. for study. Primary descriptions of the airplane were released by Vultee upon cursory examination of the craft. In this article, the chief engineer of Vultee gives an engineer's impression of the Messerschmitt after several weeks of observation and study.

The report contains a more complete external description of the airplane than was previously released, giving figures on its size, weight, span and possible range.

Contrary to certain current rumors, the Messerschmitt showed no signs of excessive use of substitute materials or any lack of instruments or radio equipment. In his description of the armament and construction of the airplane, the writer indicated that the entire construction theory seemed to be based on accessibility, simplicity of maintenance and the widest possible tolerance to facilitate easy assembly and service. Details on the engines and propellers are also provided. *Aviation*, June 1941, pages 44, 45, 142, 144, 8 illus.

Southern Aircraft's Basic Trainer. Description and performance data on the two-place basic trainer built by Southern Aircraft Corp. The new craft is an open cockpit biplane powered by either a Lycoming, Jacobs or Continental 225 hp. engine. The fuselage is built of welded chrome-molybdenum steel tubing, fabric-covered over fairing stringers of rolled aluminum alloy strips. The wings are of conventional wood construction, fabric-covered. *Aviation*, June 1941, page 95, 2 illus.

Air Policy

Numerically Superior Air Power Dominates the Course of Nations. Cy Caldwell. Recalling by quotation his prognostication of January 1938, regarding the future of air warfare, the writer pursues with a review of events and opinions his thesis that numerical superiority of German air power has been the key to her successful conquest of one after another of the European nations and Allied colonies.

His ultimate conclusion is that the United States should get into the war now and maintain control of the seas and the air, "which means sending enough land and air forces to help the British hold their naval bases around the globe." *Aero Digest*, June 1941, pages 54, 56, 206, 208, 1 illus.

Political Prop Wash vs. Plane Production. C. B. Allen. An article by a one-time member of the former C.A.A. Bureau of Air Safety points out that a recapitulation of public records shows a wide discrepancy between the number of planes referred to in various public addresses and the number the country is actually capable of producing at present and in the immediate future. *Western Flying*, June 1941, page 21, 1 illus.

Behind the Scenes at N.A.C.A. S. Paul Johnston. Besides its function as a source of experimental data, its work in checking and rechecking, proving and revising the aircraft for our national defense, the National Advisory Committee for Aeronautics also acts as a clearing house for aero-

nautical information. Although most of its reports, for military reasons, get only a limited circulation, the Committee's work is going on at an unprecedented rate.

In this article, the writer, the Committee's Coordinator of Research, explains the structure of the committee and its four main sub-committees for investigations of Structures, Materials, Aerodynamics and Power Plants.

Under each main sub-committee are subordinate committees handling particular phases of the main topic. Seaplanes, vibration meteorology and wing and windshield de-icing are typical topics that are studied under Aerodynamics. Power Plants has such subordinate groups under it as supercharger compressors, intercoolers and induction system de-icing.

The Materials group has only two general sub-committees, one on metallic materials, ferrous and non-ferrous and the other on miscellaneous materials. The Structures group has no standing bodies under it, only two organizations, one for the study of elastic examination of large aircraft structures in lieu of destructive tests, the other to direct research in applied structures. Other structural problems are considered by temporary committees which dissolve when the work is accomplished.

This article explains the general functioning of the N.A.C.A., its work at its own research stations at Langley and Moffet Fields and the manner in which specific problems are contracted to Universities and engineering schools. *Aviation*, June 1941, pages 68, 69, 160, 2 illus.

Airports

Tucson One of the Largest Air Bases. One of the country's largest airports for Air Corps base operations has just been completed at Tucson, Arizona. Equipped with every facility necessary to the operation of a major Army airport, the base is adjacent to the municipally-owned Tucson airport where additional facilities are to be provided, among them a 400 × 2,020-ft. parking area for Army planes. The joint grounds and accommodations are briefly described. *Aero Digest*, June 1941, page 78, 3 illus.

Automobile Terminals at Airports. Paul Archibald. As an authority on the planning of automobile parking and garage facilities, the writer discusses the problems unique to the planning of such accommodations at airports. Arrangements common to most airports today are described; a plan is explained for an ideal automobile accommodation at a modern airport. The plan incorporates the use of underground shelters which can be provided either for existing airports or for those now being planned with a resultant economy in space and construction cost as compared to the type of layout now used at most airports. *Aero Digest*, June 1941, pages 74, 77, 205, 2 illus.

Washington National Airport. The nation's first federally owned and operated airport, ten minutes from downtown Washington, D. C., opened in June. The National Airport has 450 acres of landing area; this size is outranked only by Tempelhof Airdrome in Berlin. The new landing field has four paved runways as now constituted, but the layout is such that paralleling landing areas and a seaplane base can be installed with little or no interruption of service. Two 200-ft. wide runways extend for 6,875 ft. and two of 150-ft. width extend 4,280 ft.

Completed 2½ years from the day the site was first dredged, the airport is held to be an unusual piece of engineering work. As at La Guardia Field in New York, a large water area had to be filled to complete the site of the new airport. The problem of paving was considerably complicated by the composition of the deposits. The problems involved in fill as well as in paving are described at length, together with the methods and materials used in accomplishing the work.

The facilities for the public, both visitors and air travellers, were planned with great care to convenience, comfort, beauty and the handling of heavy traffic, with ample room for future expansion. Parking spaces, spectator promenade, waiting room, restaurants and other service facilities are extensive. An automatic "progress board," something new at airports, indicates the position along the airways of all planes arriving or departing from Washington. The control tower and hangars are described briefly. *Aero Digest*, June 1941, pages 48–50, 52, 170, 8 illus.

Forging Airport Chain to Yukon. In a trailer to an article on Yukon Southern Air Transport and its founder, Grant McConachie, the building of a chain of modern airdromes in the northern wilderness to Yukon is described. The influence of McConachie's pioneer air transport developments over these routes as a background to this airdrome project is amplified. Dog teams and tractor trains penetrate the wilds, crews are flown to remote sites and rugged terrain begins to assume the shape of airports as this construction, urged by the U.S.-Canada Defense Board, gets under way. *Canadian Aviation*, May 1941, pages 21, 22, 36, 3 illus.

Air Transport

Yukon Southern Spreads Its Wings. The growth of Yukon Southern Air Transport from the bush freighter stage to a full-blown airline is given in this account of the vision of its founder, Grant McConachie, and his faithful aides. As early as 1934, the company was flying mining machinery and supplies to mining communities in the Yukon. It now operates scheduled service to the Yukon and Alaska from Edmonton and Vancouver, and the projection of its routes to the Orient, over Alaska, across the Bering Sea and down the China coast is now in progress. *Canadian Aviation*, May 1941, pages 20, 22, 5 illus.

Emergency Air Communications. M. de Bunsen. Communications in England, the article states, are frequently overtaxed and interrupted during the present emergency. One way of relieving the pressure is suggested—to establish a system of emergency air mail lines between important points in England, Scotland and Wales, employing light aircraft, flown by civilian pilots who are not eligible for military service. *Aeronautics*, May 1941, pages 48, 49, 1 illus.

Airline Schedules. This new publication made its first appearance with the May issue, designated Volume 1, Number 1. It is to appear monthly and contains three sections: news; domestic, Canadian and foreign flights; schedules (company time tables). Maps are located in the back of the book and include a specially designed back-cover airline map of the U.S. An uncommon feature of the publication is provided in tables of flights classified alphabetically by cities.

Gipsy Engines of the North. Dorothy Kaucher. The operations of Canadian Airways from Vancouver and Victoria to the isolated settlements of the far-flung frontiers of Canada are romantically treated in this description of the air service in Western Canada and the interesting country traversed. *Airlanes*, June 1941, pages 6, 7, 17, 5 illus.

Design for Beauty—and Business. Joseph A. Ferris. The sales philosophy behind Northwest Airlines' project for new offices (and new business) is set forth with a description of the line's Chicago ticket office which has just been opened and will be fol-

lowed by others along N.W.A. routes. *Airlanes*, June 1941, pages 8, 9, 24, 5 illus.

Bush Plane Salvaged From Ice. The step-by-step procedure employed to rescue a Bellanca Aircruiser of the Mackenzie Air Service from a frozen lake into which it had plunged is described in picture and text. *Canadian Aviation*, May 1941, pages 19, 32, 10 illus.

Civil Aviation in Australia. Notes on the wartime importance of civil aviation in Australia with a brief account of its efficient development with small financial aid. *Flight*, May 15, 1941, page 345, 1 illus.

Avigation

Know Your Computer. Warren C. Youngclaus. For flight problems usually involved in cross-country trips, conventional graphical solutions are accurate but under actual flight conditions are considered too slow a process to be practical. As substitute for this method, several flight navigation computers are presented with a description of how to use them for speedy solution of avigation problems while in flight.

Weems' navigation plotter takes the place of protractor, parallel rules, scale and dividers; it also enables instantaneous reading of reciprocal courses and bearings. The Jardur flight calculator has two sides, one for finding directly the drift angle, the other for computing speed, time and distance, as well as air speed corrections. The Dalton E-1A aerial dead reckoning computer has a circular slide rule with scales for speed, time and distance; it also has facilities for air speed and altimeter corrections.

The use of these and other types of computers is so described as to simplify the employment of extremely useful instruments which are less complicated than they appear to be. *Aero Digest*, June 1941, pages 158, 161, 205, 10 illus.

Business and Finance

Aviation's Unfinished Business. J. Parker Van Zandt. A study of some of the problems which may face the air transport industry. Prominent among these is the shipping of all first class mail by air whenever expedient. A close examination of present mail shipments indicates that the greater part of the non-local first class mail travels only 300 miles, while the average air-mail haul is 1,400.

While the loss of this long haul business would be only a fraction of the mail carried by the railroads, it would permit the airlines to increase present service on the basis of five cents per 200 lbs. per mile unit. On this basis, long haul first class mail could be carried by air without additional cost to the sender or the government.

The writer suggests the formation of a national air policy adequate to the opportunities and responsibilities of the present emergencies and post-war conditions. *Western Flying*, June 1941, pages 22, 23, 40, 2 illus. Also, *U.S. Air Services*, May 1941, pages 15, 16, 42.

Service Engineers. An account of the first meeting of the Aircraft Manufacturers' Service Association, an organization of the Southern California aircraft industry's service executives. The article outlines the objectives of the new organization and includes comments by Thomas H. Corpe, assistant sales manager of Lockheed, on the necessity for such a group. *Western Flying*, June 1941, page 31, 2 illus.

Getting the Most from Auxiliary Plants. Ronald L. Burla. An explanation of the relation between the parent North American Aviation, Inc., plant at Inglewood, California, and the two auxiliary plants at Dallas and Kansas City. By a system of remote control, the central executive office is able to provide direction and engineering for both auxiliary plants without duplication, while the manpower for actual construction is hired and trained locally. Wherever possible, subcontracting is also done in the vicinity of the individual auxiliary plant. *Aviation*, June 1941, pages 54, 55, 4 illus.

Aviation's Earning Power. Selig Altschul. A study of present fiscal conditions in both the air transport and the airplane manufacturing phases of the industry indicates that "all is not gold that glitters" in aviation. Despite the fact that traffic and express have increased, the air lines of the nation, as a whole, are showing less of a profit than they did last year. This is due in part to the fact that many of their pilots and skilled mechanical help are going into more lucrative posts in defense industries, while the Selective Service Act has further thinned their staffs. Training men to take their place is expensive.

It should also be noted that a part of the 1940 profits were of a non-recurring nature, such as the sale of airports and equipment.

In the manufacturing phase of the industry, increasing taxes and rising labor costs have made further inroads into profit a possibility. This however is saved to a great extent by the escalator clauses in most of the defense contracts. *Aviation*, June 1941, pages 100, 146.

Civil Air Defense

Air Safety for Factories. Konrad F. Wittmann. After studying the effects of air warfare on the industrial centers of Europe, the writer points out the dangers which beset many American manufacturing areas. Due to the fact that they were originally laid out for efficient operation rather than for safety from sky attack, they are in many cases easy to spot from the air.

Since these areas are frequently located close to gas works, fuel storage plants and chemical and water tanks, and lack alternate exits and rail facilities, bombs striking a single spot could paralyze an area for many hours. This article furnishes suggestions for correcting this situation and describes the theory applied in camouflaging existing structures to make them less apparent from the air. *Popular Science*, July 1941, pages 48–52, 12 illus.

Design

Aircraft Hydraulics. James E. Thompson. The first in a series of articles on hydraulically actuated systems in aircraft. This installment explains the basic principles of hydraulic action and shows how they are applied to the simple devices in the modern airplane. It begins with the explanation of a simple hand-power lift for motivating a wing flap mechanism. *Western Flying*, June 1941, pages 24–26, 9 illus.

The Tandem Twin-Engined Bomber. Camille Rougeron. The writer, a chief engineer of the French Navy, points out that the traditional twin-engined bomber has usually been inferior in performance to its contemporary in single-engined craft. Occasionally, by unique design, the bomber leaps ahead, but the fighter soon surpasses it. It is suggested that through the use of tandem engines housed inboard in the fuselage, and co-axial propellers, this performance discrepancy may be closed up, leaving the bomber in a better position both as a fighting craft and as a platform for dropping its load accurately. *Interavia*, April 3, 1941, pages 1–4.

Load 'Em Up! William D. Strohmeier. The method of design of the Piper Cub, the writer relates, is opposite to the method usually used in outlining larger airplanes. Unlike

the DC-3 and similar airplanes, the lightplane prototype is built first after very little preliminary engineering; its structure based on the simplest calculations.

After this model is flown and checked for stability, performance and comfort and all necessary changes incorporated, drawings and stress calculations are made. The article also outlines the procedure used in load-testing light aircraft. *Air Trails*, June 1941, pages 14, 46, 47, 5 illus.

Modern Cockpit Controls and Equipment. Gordon H. G. Garbett. For the benefit of newcomers in the industry, this is a survey of modern airplane controls. It explains the construction and rigging of aileron, elevator and rudder controls, and the operation of undercarriage and flap systems, throttle and mixture controls and the controllable pitch propeller. The adjustment of the modern pilot's seat, oxygen supply and emergency equipment is also explained. *The Aeroplane*, May 9, 1941, pages 531, 532, 8 illus.

The Cost of Speed. W. Tye. There are three ways, this writer states, of increasing speed in aircraft. One is to clean up the lines of the design by further streamlining, another is to increase power and the last is to increase wing-loading.

This article makes no attempt to forecast the method by which greater speed may be attained in the future. Rather, it states what sacrifices in performance must be made to secure the increased speed, and devises a scale by which the cost of this performance in range, comfort and maneuverability may be measured. *The Aeroplane*, April 11, 1941, pages 422, 423, 5 illus.

Air Brakes. W. O. Manning. In modern fighting tactics, it is essential for a fighter airplane, diving at a bomber, to be able to slow down to approximately the bomber's speed for a successful attack. The use of air brakes, thus far, has been the best solution. The article discusses the various designs of brakes, and suggests the use of the propeller, turned to zero or slightly negative pitch as a braking device. *Aeronautics*, May 1941, page 51, 1 illus.

Structural Applications of Plywood. Keith Rider. This general discussion on plywood applications to aircraft structures points out that while plastics as such have made valuable contributions in aircraft manufacture, they have yet to be used exclusively as the basic structure of an airplane. New chemical processes for bonding have revolutionized plywood fabrication, but have not changed its character; therefore plywood cannot be termed a plastic.

The history of ply bonding is traced briefly. Its use as developed for airplane structures is reviewed from the first such design, the Lockheed Vega, introduced in 1927, down to today's advanced applications of plywood. Various comparisons of plywood to metals as a structural material are made to show that besides its many technical advantages plywood compares favorably in other respects.

The fact that plywood airplane construction is adaptable to mass production and requires fewer skilled workers is particularly stressed. "By a combination of the forces of necessity and merit," the writer says, "wood is assuming more importance as an aircraft material." Illustrations accompanying the article indicate the basic uses of plywood for frame and covering in the Doak airplane. *Aero Digest*, June 1941, pages 144, 146, 148, 9 illus.

Wing Mounting of Aircraft Machine Guns. Louis Bruchiss and James E. Dougherty, Jr. A study of the installation of 50 cal. machine guns in the wing of a modern fighter airplane. The special structural considerations for the accommodation of both guns synchronized to fire through the propeller and those firing automatically outside the propeller arc are given. *Aviation*, June 1941, pages 87, 166, 2 illus.

The Fowler Flap. Harlan D. Fowler. The inventor of the well-known American type of wing flap reviews its history and its applications to aircraft design. Conceived in 1916, the Fowler flap went through twenty years of transition before it was first practically applied to extensive commercial use, on the Lockheed 14 in 1937. This transition period is described along with other types of flaps developed during the same period. Recounting the advantages of the flap, the writer states that large airplanes of 20,000 lbs. and over are particularly suited to the application of this flap. He predicts future wing loadings of as much as 75 lbs. per sq. ft. *Flight*, April 17, 1941; pages 284-f to 284-h, 3 illus.

Engines

Aero Engine Cooling. Edward A. Smith. A study of the principles of engine cooling directly by air, and by means of radiators. The basic physics involved in heat conveyance are explained and applied to the problem of transferring the heat generated by the explosion of gases inside the cylinder through the cylinder wall to the surrounding air. *Aeronautics*, June 1941, pages 51–53, 7 illus.

Characteristics of Exhaust-Gas Analyzers. J. L. Dilworth. A report on a series of tests to determine the dependability of exhaust gas analyzers. The tests were conducted at the Virginia Polytechnic Institute on a single-cylinder variable-compression test engine.

Six analyzers were tested. Two of them were of the thermal-conductivity type, one of the hot-wire catalytic type, another of the relative density type, while the remaining two employed the Orsat principle. While these six, the writer points out, did not represent all the makes on the market, they did cover every general type applicable to automotive service.

The report showed that all the instruments ceased to function when the air-fuel ratio became leaner than 14:1. It concluded that exhaust-gas analyzers were not precision instruments, being likely to err as much as one-half of one air-fuel ratio. It further indicated that the analyzers were calibrated for regular commercial gasoline, and that they would require recalibration for any fuel with a different chemical composition. *S.A.E. Journal*, June 1941, pages 234–239, 9 illus.

The Story of the First Australian-Made Gipsy Major Motor. As part of the Empire Air Training Scheme, the Australian Ministry of Supply and Development gave General Motors-Holden's Ltd. the task of building the Gipsy Major Series I 4-cylinder inverted air-cooled engine in Australia. These power plants were for the Tiger Moth training biplanes also being built in the Commonwealth.

The production of these engines required converting much of the company's machinery from metric to linear measure. The changes in equipment and procedure, the new machines that had to be installed and the assembly methods that were developed for the specific problem are explained. *The Aeroplane*, April 25, 1941, pages 466, 467, 2 illus.

Pendulum Dampers. Dr. W. Ker Wilson. A study of the application of dynamic damping to the six-in-line Gipsy engine. The article describes the absorbers themselves, and the manner in which they were installed. Torsiometer tests indicated a decrease in torque vibration after the dampers were installed. *The Aeroplane*, May 2, 1941, pages 502, 503, 5 illus.

Aircraft and Engine Review. A review of some British and American airplane engines, including specifications, pictures and descriptions of power plants in commercial and military service. They are grouped separately under each of the two countries without classification by size or use. In some instances, the descriptive data are fuller than usual in this type of engine review. *Commercial Aviation*, May 1941, pages 71–80, 16 illus.

Exhaust Efflux Propulsion—V. F. W. Lanchester. The first four articles of this series appeared in *Flight* for Nov. 16th and 23rd, and Dec. 7th and 14th, 1939. In this final analysis, the writer gives a generalized solution, the final results being tabulated and given in the form of diagrams. The article also contains a brief review of method as applied to the condition of supercharging, which was not touched upon in the previous articles. The general conclusion drawn is that about ten per cent of the engine power is available for auxiliary propulsion. *Flight*, April 17, 1941, pages 285, 286, 2 illus.

Electric Petrol Injection. Notes on a system of direct petrol injection which was used with success in an Italian racing car some time ago. The system, known as the Caproni-Fuscaldo, is based on an external tube containing a very small and light valve operated electrically. The system as used on the racing car is described and its possible application to airplane engines is discussed briefly. *Flight*, April 17, 1941, page 284-e, 2 illus.

Exhaust Manifolds. Ralph Haver. Ryan Aeronautical Company's manifold engineer explains in detail the results of the company's considerable research and testing in the development of an exhaust manifold suitable to higher horsepower aircraft engines and to dynamic suspension mounts. The ring collector so developed is known as the universal joint exhaust manifold and is commonly referred to as the Ryan "ball and socket" collector. It is used extensively on many advanced-type military and commercial airplanes.

This collector ring not only provides long life and low maintenance features, but adds also to the life of the power plant itself by reason of its unusual type of support. The Ryan collector, instead of being supported on the engine, is supported by the engine mount or cowl well by a series of links and is connected to the engine exhaust ports by the use of universal joints. This arrangement eliminates hanging the collector on the engine exhaust ports and permits the universal joints to absorb the movement between the manifold and the engine, thus handling the excessive movement found in engines using dynamic suspension type mounts.

A very detailed account is given of the design, manufacture, operation and maintenance of this collector ring and variations of it which have been tested in the course of its development. *Aero Digest*, June 1941, pages 150, 153, 154, 157, 206, 27 illus.

Major Tendencies in Aero Engine Design. Transcription of an interview with Major Frank B. Halford, designer of the de Havilland and Napier series of air-cooled engines. Halford discusses the subjects that modern engine designers are considering when they seek to formulate plans for future designs. They are engine shapes, supercharging for high altitude work, direct injection of fuel, and sleeve valves.

Although the horizontally opposed engine buried in the wing would be ideal for many designs, such an engine would be impractical due to the thinness of the wing section in current use. Furthermore, the skin stressed structure in current use precludes the cutting of large openings in the wing which would be necessary for servicing this type of installation. The remaining types—the single and double-row radial, the Vee-type and the H-type—are compared as to frontal area.

The advantages and problems involved in the exhaust driven supercharger are explained and the application of the exhaust as partial jet propulsion is mentioned. Six important advantages of direct fuel injection are listed. Finally, some of the advantages of the sleeve over the poppet type valve are given, which include simpler maintenance and less complicated manufacture. *Aeronautics*, June 1941, pages 74–76, 9 illus.

The Cartridge Starter. John M. Hearn. Description of the Breeze cartridge-type starter which, through the use of gaseous pressure generated from a shell the size of a shot-gun cartridge, can start a high-powered aircraft engine. The material in the cartridge has slow burning characteristics very similar to those of commercial celluloid. *Western Flying*, June 1941, pages 36, 37, 4 illus.

The Ford V-12 Aircraft Engine. Paul H. Wilkinson. A description of the V-12 1,500 to 1,800 hp. liquid-cooled aircraft engine being built by the Ford Motor Company as a private enterprise completely without aid or suggestions from the government. The new power plant, equipped with an exhaust-driven supercharger and with intercoolers between the banks, uses centrifugally-cast parts wherever possible. Bursting tests have indicated that parts thus cast are 50 per cent stronger than the forged type due to greater resistance to fatigue though they require less machining. *Aviation*, June 1941, pages 93, 166, 2 illus.

El Peligro del Hielo en los Carburadores (The Danger of Ice in Carburetors). Discussion of the formation of ice in carburetors, the atmospheric conditions which favor it and the means for its prevention. *Aeronautica*, April-May 1941, pages 42, 43, 47.

La Turbine Remplacera-t-elle le Moteur à Explosions Pour la Propulsion des Avions? (Will the Turbine Replace the Internal Combustion Engine in Airplane Propulsion?) The conclusion of an article introduced in the February issue of this publication. The shortcomings of internal combustion engines under certain conditions are given, comparing these with the efficiency of turbines under similar circumstances. As evidence, the article presents data from a series of experiments conducted by the Great Lakes Aircraft Corporation in their effort to develop an aircraft type turbine. *Schweizer Aero-Revue*, April 1941, pages 10, 11.

Numerical Calculation of Power Variation with Altitude in a Naturally Aspirated Engine by Means of J.S. Diagrams. Keikichi Tanaka, Osamu Tamura and Osamu Konisi. This paper deals with the changes in the theoretical i.m.e.p. of a naturally aspirated engine with altitude from sea level to 15,000 meters.

In calculating the i.m.e.p., J.S. diagrams of air and combustion gases, constructed by one of the writers, were used. In these calculations the changes in specific heat of both air and gas with the temperature as well as the degree of dissociation of the combustion gas with the temperature and pressure, were taken into consideration. Formulas are derived to furnish satisfactory calculations for mean effective pressure and for indicated horsepower for heights below 11 km. *Report of the Aeronautical Research Institute, Tokyo Imperial University*, No. 204, February 1941, pages 1–31, 15 illus.

Petrol Pump v. Carburetor. E. W. Knott. An engineer who has been in the carburetor business since 1914 and has visited every automobile factory in Europe, except Russia, gives his views on this much discussed subject.

Favoring carburetion whole-heartedly, he brings out one reason said to be missing from the discussion to date—"the appalling vibration which takes place when one cylinder of an injection engine cuts out due to stoppage of the discharge nozzle."

The standard of workmanship as well as the standard of labor required to put injection pumps into production, apart from repair and service, are reiterated and compared with the comparative simplicity of carburetor production and servicing. *Aircraft Production*, May 1941, page 164.

Fuels and Lubricants

Relationship of Viscosity to Rate of Shear. L. J. Bradford and F. J. Villforth, Jr. This paper reports tests intended to check the validity of the assumption that lubricating oils belong to the class of a Newtonian fluid, which is defined as one in which the force required to shear it is directly proportional to the rate of shear.

It is on this assumption, questioned in recent years, that equations for the behavior of bearings have been based. Experimental evidence is produced in support of Petroff's equation which states that the torque required to rotate a journal, concentric with its bearing, is directly proportional to the product of the absolute viscosity and the rate of shear of the fluid separating the journal and the bearing. *Transactions of the A.S.M.E.*, May 1941, pages 359–362, 10 illus.

Report of CFR Committee on Aviation Vapor-Lock Investigation. O. C. Bridgeman. A summary of the progress reports submitted during the past year on the problems of vapor-lock in airplane fuel systems. Four methods for controlling vapor-lock are considered: Controlling fuel characteristics, fuel tank supercharging, fuel cooling and compromise methods consisting of local and temporary methods, expedient in the case of a particular aircraft design. *S.A.E. Journal*, June 1941, pages 213–217, 4 illus.

Gliding and Soaring

Air Transport by Glider. Some technical observations on multiple glider towing by aircraft reveals many interesting facts. The ratio of weight of the train of gliders to the weight of the towing airplane directly influences the speed of the entire train. The higher the speed of the towing airplane, the more efficient the train will be.

This article analyzes the power required for a glider train in level flight, its speed and climb, and indicates the best type of airplane and design of glider for this work. *The Aeroplane*, April 25, 1941, pages 476, 477, 5 illus.

Schweizer Hochleistungs-Segelflugzeug Typ Spyr IV (The Swiss High-Performance Glider Type Spyr IV). A. Hug. Description of the Spyr IV, a full-cantilever, gull-winged, high-performance sailplane. Attention is drawn particularly to the wing design which incorporates a special taper and high aspect ratio. *Schweizer Aero-Revue*, March 1941, pages 16, 17, 21, 22, 8 illus.

Towed Glider Tactics. W. E. Hicks. Directions for preparing the terrain to make the landing of troop-carrying gliders extremely hazardous. It is suggested that open fields should be planted with stout posts protruding only a few inches above the surface which would rip open the fuselages without knocking off the wings of hostile gliders.

The tactics used in protecting gliders from attack by fighter airplanes from the time they are cut loose from the towing craft to the time they land are explained, and a method for circumventing these tactics is suggested. *Aeronautics*, June 1941, pages 66, 67, 2 illus.

Site for Soaring Eyes. Alexis Dawydoff. It is extremely difficult, the writer points out, for one glider pilot or group to locate and maintain a glider site. One solution to this problem is for several glider clubs to band together and develop a site between them, sharing the expenses. The cost of some of the improvements can be paid by renting storage space and charging a towing fee. Standards for selecting good glider sites, their size and location are provided. *Air Trails*, June 1941, pages 22, 62, 5 illus.

High Altitude Flying

Höhenflug (Altitude Flight). The last in a series on high altitude flying, this installment considers the problems of supercharging and insulation, and the cause and prevention of ice formation. The over-weather test flights made by D. W. Tomlinson of T. & W. A. are discussed. Included is a list of pressurized cabin-equipped aircraft in use and under construction. *Schweizer Aero-Revue*, March 1941, pages 9, 10, 1 illus.

A Que Altura Llegaremos? (What Altitude Can We Reach?) Altitude flight is discussed from the standpoint of the maximum altitude man may be able to attain. A chart illustrates the layers of atmosphere about the earth and shows the altitudes reached by various efforts so far, as well as the altitudes reached by sounding balloons. Stratosphere airplanes and engines are briefly treated. *Aeronautica*, April-May 1941, pages 30, 31, 37, 46, 3 illus.

Altitude Conditioning of Aircraft Cabins. James B. Cooper. A report on experience in the development of the cabin-pressurizing system used in the Boeing Stratoliner. The article indicates the need for supercharged cabins because of the physiological inability of the human body to obtain sufficient oxygen at reduced air pressures. The paper explains the engineering and installation of the pressurizing system and how ventilation standards have permitted bleeding of a minimum of cabin air and recirculation of a considerable portion of the pressurized air. *S.A.E. Journal*, June 1941, pages 240–248, 5 illus.

History

Birth of a Great Fighter. C. M. Poulsen. An account of the background of collaboration out of which the Typhoon, successor to the Hurricane, was developed by Sydney Camm and Maj. Frank B. Halford. The former designed the aircraft, and the latter originated the Napier-Sabre H-type engine which helps to give the Typhoon its outstanding performance. The developments by each of the collaborators are described as they gradually converged over a period of time at a point where the best work of both designers was incorporated in the Typhoon. *Flight*, May 8, 1941, pages 328-f to 328-h.

The Air Ministry News Service States... Frank Willcox. The history of the Air Ministry News Service, the official news outlet of the British Air Ministry, whose task it is to keep the press of the world informed on the activities of the R.A.F. Most of the men serving in this unit of the Public Relations section of the Air Ministry are newspapermen and specialists in aeronautical writing who received special training under the direction of the R.A.F.

Full vindication of the plan, which was looked on with suspicion by many when it was first conceived in 1938, came during the war in France and the attack on England last August. The A.M.N.S. then kept complete news service going whenever engagements took place. *Aeronautics*, May 1941, pages 38, 39, 1 illus.

The First Power-Operated Gun Turret. Squadron Leader C. A. Rae. The totally enclosed power-driven gun turret was developed by Boulton and Paul Ltd. when the increased speed of the Sidestrand twin-engined bomber made it difficult for the gunners to operate in open cockpits with manually turned scarfmounts.

This history relates some of the amusing incidents which occurred during the early experiments with the power driven turrets and traces their application from the Sidestrand and Overstrand bombers to the modern Boulton-Paul Defiant. *Aeronautics*, June 1941, pages 77, 78, 1 illus.

Instruction

Principles of Vocational Training. T. Lee, Jr. The director of the Boeing School of Aeronautics analyzes the trend from the academic to vocational education and the present search for a way to combine the advantages of both the academic and vocational schools to the end of a full education. Industry still looks to vocational schools for young persons adequately trained for specialized occupations. Such trainees are usually of limited value to an employer, however, unless they possess more than a technical training.

The distinction between *education* and *training* is clarified and the measure of each attained by the current curricula of commercial and company aviation schools is noted. *Utility* is urged as the yardstick for measuring the results of secondary and college education. Using this as a standard, public schools should be provided with facilities for coordinating the teaching of academic subjects with the occupational application of those subjects. Class-room theory should be followed by shop practice, then by a period of apprentice service at an overhaul base to qualify an individual as an engine mechanic.

This discussion, though somewhat academic and general in treatment, offers pertinent information on the educational philosophy behind Boeing School and useful suggestions on aeronautical training in general. *Aero Digest*, June 1941, pages 70, 72, 202, 4 illus.

Fire Safety. E. N. Whittington. Maximum speed in production and maximum intake of new workers call for a more effective program than ever before in the fire safety training of aviation workers. Trade schools can hardly duplicate every condition under which men work in the various defense plants. But they can provide the basic fire safety information which under almost any condition will enable the worker to protect himself and the plant in which he is employed.

Pointing out many of the fire hazards encountered in aircraft production, this article indicates the precautions that can and must be taken to prevent such hazards in the various phases of production where they are most prevalent. Three major types of fire are described together with the measures necessary to fight them. *Aero Digest*, June 1941, pages 58, 60, 62, 5 illus.

Training with the R.C.A.F. Dudley Avery. An American pilot describes the program of Canada's advanced bimotor training schools where qualified American pilots are accepted with open arms and prepared to join the R.C.A.F. or contract out as civilian primary instructors for work similar to the civilian pilot training program in this country. *Southern Flight*, June 1941, page 12, 2 illus.

The Southeast Pilot Mill. Facts and figures on Army Air Corps training operations throughout the Southeastern part of the country, where eight Air Corps bases and ten civilian primary air schools under contract to the Air Corps are turning out pilots in growing numbers. *Southern Flight*, June 1941, pages 9, 16, 1 illus.

Como Estudiar Ingenieria Aeronautica (How to Study Aeronautical Engineering). The National University of Cordoba in Argentina presents an outline of a five-year course of study in aeronautical engineering. A complete listing is given of the required subjects and the units of theory and practical work required, semester by semester. *Aeronautica*, March 1941, pages 27, 41.

Installing instruments in the nose section of a Maryland bomber at The Glenn L. Martin factory.

Die Vorschulungskurse der Fliegertruppe (Preparatory Courses of the Swiss Air Corps). Capt. W. Wagner. Impressions and experiences of a Swiss infantry officer who was transferred to the air corps. He describes the courses in aeronautical theory and the physical training which precede the cadet's first flight. *Schweizer Aero-Revue*, April 1941, pages 17, 18, 9 illus.

30,000 Pilots 100,000 Mechanics a Year. Brig. Gen. Davenport Johnson. The chief of training and operations of the Army Air Corps outlines the rapid expansion of Air Corps personnel in all branches. On June 1 of this year officers numbered approximately 10,000, an increase of about three times over a year ago. The present training program is being stepped up from 12,000 to 30,000 pilots annually. The number of mechanics will be increased from 45,000 to 100,000 men, while navigators, gunners, bombardiers and observers will be increased proportionately. The coordination which has been worked out between military and civilian schools is explained to indicate how this expansion in the training program is being met. *Aviation*, June 1941, pages 38, 39, 3 illus.

Pilots and Mechanics for the Navy. Rear Admiral J. H. Towers. The problem of training adequate flying and mechanical personnel for the Naval Aeronautic Organization rates high priority in the Navy's four-fold program of equipment, training, shore base and marine expansion according to the writer, Chief of the Bureau of Aeronautics, Navy Department. In this article, he outlines the training expansion and acceleration program which will result in a total of over 6,000 Naval aviators by 1942.

A wide variety of mechanics and technicians are being trained at mechanics schools at Jacksonville, Norfolk, Pensacola and San Diego, while at several bases civilian mechanics, accepted through Civil Service examinations, are hired and trained for major overhaul work. *Aviation*, June 1941, pages 40, 41, 160, 1 illus.

Instruments

Taking Out the "Static." "Elektron." This article explains the appearance of acquired magnetism in the frame of an airplane due to its continuously cutting the earth's magnetic lines of force. If this magnetism is concentrated near the cockpit, it may interfere with the accuracy of the aperiodic compass.

This magnetism may be removed by a process known as de-gaussing—destroying the definite polarity of the magnetized part. This is accomplished by means of a choking coil, *i.e.*, a coil of wire wound around a laminated soft iron core. Alternating current is passed through the coil and an alternating flux is produced.

The nature of this apparatus and the method by which it is applied to the affected parts of the airplane is described. *The Aeroplane*, May 16, 1941, pages 557, 558, 2 illus.

New Ideas in Aircraft Instruments. E. B. Moss. Descriptions of the operational theory of engine instruments in common use. The working of various types of fuel and manifold pressure gages, thermometers, flowmeters, thermocouples, tachometers,

ice indicators and exhaust analyzers are outlined in this article. *Aeronautics*, May 1941, pages 40–42, 2 illus.

Instrument Flying

The Compass in a Turn. An explanation of "Northerly Turning Error," a none too accurate term for compass inaccuracies which occur when an airplane is maneuvered into such a position as to put the card at an angle to the earth's surface. *The Aeroplane*, April 18, 1941, pages 449, 450, 5 illus.

Radio Plus Lighting Equals Safe Landing. David S. Little. A brief review of progress in the development of instrument landing systems and techniques. It is said that while we do not yet have a national and a fully acceptable system for instrument landing of aircraft, progress is constantly being made on what has become an "economic necessity."

Research and development on instrument landing in this country began with the Bureau of Standards in 1928. Its system comprised a runway localizer and marker beacons; attitude was controlled by barometric altimeter. Using this system without the aid of the marker beacons, "Jimmy" Doolittle, now a major in the Air Corps, made the first successful instrument landing in 1929. Radio guidance in the vertical plane using a constant-intensity glide path was devised the same year, providing a three-dimensional system when used with the runway localizer.

Progress in aerodynamics, engines, aircraft instrumentation and airline service has been too rapid, it is said, for the complexity of radio and lighting to keep pace. However, by 1939, the C.A.A. instrument landing system was completed and demonstrated, showing notable improvements; it is now entering the service test stage. A brief description of it is given without technical details. Present C.A.A. developments contemplate changes in the materials employed.

Allusion is made to the contrasting instrument landing requirements for military and civil aircraft, though some elements are of mutual value. Lighting problems, particularly from the viewpoint of the airline pilot, are discussed in detail. *Aero Digest*, June 1941, pages 65, 66, 69, 205, 4 illus.

Materials

"Dope." It is now over thirty years since the manufacture of airplane dopes began in a very small way. The history of "Cellon," manufactured by Cellon, Ltd., is outlined in this article. Its development from cellulose acetate to synthetic finishes and the changing requirements which have produced new materials and new methods are traced briefly. *Flight*, April 17, 1941, pages 287–290, 10 illus.

Rubber—Strategic Material. Howard E. Jackson. Rubber, both natural and synthetic, is one of the important materials used on airplanes, and is important as a strategic material. Many of the uses of rubber in aircraft, as in tires, de-icers, paints and tubing are listed, and the article explains how certain jobs require natural rubber, while synthetics serve better for others. The method for manufacturing and testing airplane tires and the theory and functioning of aircraft de-icers are also presented. *Western Flying*, June 1941, pages 32–34, 3 illus.

Aluminum and Magnesium. Raymond Hoadley. A forecast on the amount of aluminum and magnesium that national defense will require in the next twelve months. This survey indicates that while aluminum production increased from 25,000,000 lbs. in January to nearly double that currently, the nation is still short of metal for the nation's non-defense needs. In April, the aircraft industry consumed 40,000,000 of the 48,000,000 lbs. that were produced. It is hoped that by the end of this year, monthly production will have reached 75,000,000 lbs. per month.

The magnesium situation is less encouraging. Despite fourfold production expansion, supply is nowhere near demand, due chiefly to the need of magnesium as a basic material for incendiary bombs. *Aviation*, June 1941, page 70, 1 illus.

Medicine

Eyes and the Airman. W. E. Hick. This simplified study of the structure of the human eye explains its operations and limitations and how they affect the pilot. Night blindness (Nyctalopia), and its cure, the structural blind spot of the eye and how it can be dangerous, and the sterioptic action of the eyes and their application to landing are discussed. *Aeronautics*, May 1941, pages 54–56, 6 illus.

Picking 40,000 Pilots a Year. Before the end of 1941, the air services of the Army and Navy expect to accelerate their training program to 40,000 pilots annually. This is three times the number trained up to last Spring. Due to rigid physical and educational prerequisites, it proved difficult to secure the 70,000 volunteers required as pilots.

Lowering educational standards has proved of some help in recruiting, but the physical requirements still remain high. The routine is explained for selecting candidates with the physical constitution required for military flying. The mechanics of testing vision, heart condition and coordination, and of measuring brain waves and basal metabolism are described. *Popular Science*, July 1941, pages 70–72, 8 illus.

Metallurgy

Heat Treatment With Controlled Atmosphere. A description of new American heat-treatment processes and types of equipment for the quantity hardening of alloy steel parts without change of the chemical composition and finish of the surface metal. One process uses Endogas, which is produced from fuel gas such as natural gas, illuminating gas or propane, in a reaction unit separate from the electrically heated furnace. Another new controlled-atmosphere method utilizes lithium as a neutralizing agent. Methods for simultaneous treatment of different alloys are also explained. *Aircraft Production*, May 1941, pages 186, 187, 2 illus.

High-Speed Tension Tests at Elevated Temperatures—Parts II and III. A. Nadai and M. J. Manjoine. Report of an investigation on the resistance to plastic forming of several metals over a wide range of rates of deformation at various temperatures. To carry out the tests, two machines were built: one, a high-speed testing machine, was described in Part I of the report; the other, a constant-strain-rate machine, is presented in Part II.

The general trend of the test results for aluminum and copper indicates a continuous increase of the yield stresses with the strain rate. The speed relation for pure iron and the iron alloys seems to be much more complicated. The resistance to deformation at a given speed of straining exhibits a minimum and a maximum at certain temperatures. This maximum, known as "blue brittleness," shifts to higher temperatures with increasing speeds of straining; it appears at 200°C. for short-time tension speeds and shifts to 550°C. for the high speeds. In the high-speed tests a local temperature rise of 50°C., due to the conversion of the work of deformation into heat, was observed in a specimen of pure iron.

At very rapid rates of deformation remarkably high ultimate stresses were found for aluminum and copper when tested at temperatures approaching their melting points. A theory for the necking of a bar, based on the speed law, predicts the observed shapes of broken bars which were drawn down to a point. Observation data are furnished on an evaluation of the forces required for very rapid plastic forming of the metals at high temperatures, particularly through rolling. *Journal of Applied Mechanics*, pages A-77 to A-91, 33 illus.

Effect of Temperature on Coiled Steel Springs Under Various Loadings. F. P. Zimmerli. Results of tests on the effect of various stress-temperature combinations on steel springs are presented in the form of charts developed from a great number of tests.

For the carbon steels tested, it is shown that there is a temperature-stress equilibrium point at about 400°F. Below this point there is a definite temperature-stress equilibrium. Above this point it is simply a time-temperature curve since, eventually, the springs will fail. The report draws particular attention to the value of various strain-relief heatings after coiling.

Tests on springs hardened and tempered after coiling, as compared with those made of pretempered wire, give no evidence that the former method is preferable. This is contrary to the general understanding in the industry.

It is shown that for each type of material there is an optimum Rockwell hardness for best heat resistance. Both S.A.E. 6150 and 9260 steels have greater resistance to load losses due to heating than carbon steels. They in turn are exceeded by 18–8 stainless and high-speed steels. A difference in time between ten days and three days to reach true temperature-stress equilibrium exists between the various steels. *Transactions of the A.S.M.E.*, May 1941, pages 363–368, 31 illus.

Ein Beitrag zur Metallographie der ausscheidungsfähigen Phase $CuAl_2$ in technischen Al-Cu-Mg-Legierungen (A Contribution to the Metallography of the Separable Phase $CuAl_2$ in Technical Al-Cu-Mg Alloys). R. Mechel. Separation of CuAl, in technical Al-Cu-Mg alloys takes place if the material is annealed beyond 200°C. Crystalline arrangement and quantity of the separations depends on the heating temperature and on the pretreatment of the material. Abrupt cooling from 500° results in a twin formation, of which the first separations of $CuAl_2$ occur after heating at 200°. Slow cooling followed by annealing creates a structure which is very similar to that of troostite in steel.

All separations are reversible, *i.e.*, they may be brought back into their former state by means of annealing at 500°. However, separations which take place on the welding seam during autogenous or electric welding cannot be brought back. Their effect on the characteristics of the material therefore is essential and lasting. *Luftfahrtforschung*, March 1941, pages 107–110, 14 illus.

Forming aluminum tubing at the Aluminum Company of America's plant in Lafayette, Indiana.

Case Hardening. John F. Wyzalek. Case hardening, which follows the carburizing of iron base alloys, is accomplished by suitable heat treatment of all or part of the surface portions of a piece of iron base alloy. This article treats exclusively of that phase of carburizing which utilizes gaseous media, which are being increasingly used in industrial applications. *Heat Treating and Forging*, May 1941, pages 237–240, 3 illus.

High Temperature Metallic Resistor Furnaces. W. Kroll. The rapid development of various materials requiring high-temperature treatment has created a demand for suitable furnaces, which form the basis of this discussion.

For temperatures above 1200°C., metallic resistor furnaces use molybdenum or tungsten resistors and operate under a gas seal or in a vacuum. The specific behavior of molybdenum and tungsten as resistors, various refractories and furnace atmosphere are discussed. A high-temperature metallic resistor furnace of the core type is illustrated and explained. *Heat Treating and Forging*, May 1941, pages 241–243, 1 illus.

Unusual Type of Small Parts Hardening Furnace. A new type of continuous gas furnace for case-hardening of a wide variety of small parts is described. The parts so processed in the furnace, the steel from which they are made and details of the heat treatment are explained. The furnace incorporates a number of constructional and operating innovations. *Heat Treating and Forging*, April 1941, pages 187–190, 4 illus.

Meteorology

On the Occurrence of Dry, Stable Maritime Air in Equatorial Regions. C. E. Deppermann. It is pointed out that some types of maritime air, such as the South Pacific trade, though long in the equatorial regions, can remain quite dry and stable, not only while in such regions but also after leaving them for higher latitudes. It may be that passage through a frontal zone, convergence from other causes such as Coriolis force or the pressure gradient surrounding continental heat lows, transit over warmer water surface, or even orographic effects may have much more to do with the wetness of some equatorial maritime air masses, like the true southwest monsoon of the Indian Ocean, than merely lengthy passage through the tropics aided only by local heat convection. *Bulletin of the American Meteorological Society*, April 1941, pages 143–149.

A Study of Fog and Low Cloud at Pendleton, Oregon. Thomas E. Jermin. The statistics of fog and low ceilings at Pendleton are discussed in relation to the topographic situation, prevailing winds, type of fog process, etc. The explanations require careful attention to topography. November to January is the foggy season; radiation, prefrontal and advection are the chief types, but postfrontal and upslope fog also occur. Typical situations for each are illustrated. The

forecasting by use of Brunt's radiation equation or the methods of George has not yet been satisfactorily worked out; some forecasting rules are cited, however. *Bulletin of the American Meteorological Society*, April 1941, pages 151–161, 9 illus.

A Completely Automatic Balance for Inflating Pilot Balloons, With Compensation for Friction. L. W. Pollak. A new balance for inflating pilot or sounding-balloons, using the principle of the Robervaal balance, is described. The essential features are as follows: the variable weight of the empty balloon and all friction and bending resistances are compensated before filling is commenced by means of a self-moving weight which stops automatically at the point of equilibrium. A valve automatically turns off the gas-supply at the moment the balloon attains the prescribed free lift. *Bulletin of the American Meteorological Society*, April 1941, pages 163–165, 2 illus.

Military Aviation

A Comparison of Opposite Numbers. The first in a series of articles comparing current types of aircraft with the ones they are most likely to meet in combat. In this installment, the Armstrong Whitworth "Whitely" night bomber is compared with the Messerschmitt 109 and 110.

The comparison is unfavorable to the Messerschmitts due chiefly to the fact that the offensive armament on both the 109 and 110 is fixed and depends largely on shell firing ordnance. In night fighting, it is difficult, under most conditions, to see the entire airplane and to make a direct hit in a vital place. The flexible power-driven multi-gun turret, on the other hand, can follow the moving target with a stream of fire. *Aeronautics*, June 1941, pages 72, 73, 3 illus.

USSR Air Force. H. J. A. Wilson. In a survey aimed at giving an unbiased picture of Soviet air strength, the writer uses official and unofficial German information as a basis for his figures since the Soviet air force was originally set up by German experts.

Despite several interruptions, this unofficial collaboration continued until 1937. At this point all Russian airplane plants were about to be converted to the production of German types. At the last minute, American designs were substituted.

The structure of the U.S.S.R. air force, which is divided to serve under the Commissar for Defense and the Navy, is explained. Estimates are provided for its strength in men and airplanes, based on a study of growth since 1934. Reports made by the Condor Legion—German pilots who fought in the Spanish Civil War—indicate that the Russian pilots were well trained and on a par with the average western aviator.

The organization and equipment of parachute troops and anti-aircraft units are explained. The Ossoaviachim, an organization built along the lines of the Italian RUNA and the German N.S.F.K. for pre-military training, has a membership of 15,000,000, and provides most of the candidates for these military units.

An estimate of the plant capacity and a description of the available equipment is provided as well as a brief discussion of the transport facilities which have been expanded to make up, in part, for the lack of ground communications in certain parts of Russia. *Aeronautics*, June 1941, pages 40–46, 6 illus.

Stratosphere Bombing. D. W. Tomlinson. Before the end of the present war, the writer predicts, a great deal of bombing from altitudes of 40,000 feet will take place. Speculation on the problems and tactics of this type of warfare suggests that the bomber has the advantage over the interceptor.

Bombers, having sealed cabins and heating systems, give their crews the comfort of normal-level flying, while the interceptor pilot is hampered with oxygen tubes and supercharged suits which interfere with both vision and movement. *Air Trails*, June 1941, pages 11, 42, 4 illus.

Air and Army in the Future. Major F. A. de V. Robertson. A review of the important functions of aircraft in military warfare as indicated by the experience of World War I, the present war and prognostications for the future. Much of the article is devoted to the various reconnaissance services which can be performed by aircraft and potential developments in instruments, cooperative activity and strategy designed to heighten the efficiency of air reconnaissance service. *Flight*, April 10, 1941, pages 270-a to 270-e, 10 illus.

They Can Take It. A description of the armored target boats used by the R.A.F. for bombing practice. The armor of the craft is devised to withstand bomb-shock and provide protection for the crew without making the boat top-heavy. The use of Onazate to ensure ample reserve of buoyancy in case of a direct hit is explained. *Flight*, April 10, 1941, pages 270-f, 270-g, 4 illus.

Dog Fighting. Hickman Powell. A study of the advanced course in pursuit flying and combat gunnery given pilots at regular Air Corps posts such as that of the 35th Pursuit Squadron at Mitchel Field. The article explains the modern technique in combat flying and outlines the procedure in gunnery instruction and practice which aids the pilots of the P-40 pursuits in achieving and maintaining the *Expert* gunnery rating required for pursuit aviators. *Popular Science*, June 1941, pages 106–112, 220, 9 illus.

Langstrecken-Bomber (Long Distance Bomber). E. Amstutz. A study of the long-range bombers in active use in the present war and of the American-built commercial and military airplanes used for long-distance operation. The writer notes among other comments that the percentage of the total weight available for fuel is greater in long-range aircraft than in those of smaller dimensions. *Schweizer Aero-Revue*, March 1941, pages 13, 14, 3 illus.

Dress Rehearsal for Air Combat. Ronald A. Keith. The writer's description of an experience as a passenger in a Douglas attack bomber in sham battle with Curtiss pursuit airplanes. The article reflects the intense seriousness and success of the Royal Norwegian Air Force's training operations at its Toronto base.

In a trailer to the above account, the writer describes at length the cockpit, instruments, fire power and operation of the Curtiss P-36 pursuit craft. Considering the sequence of operations in flying this airplane to be basically the same as the flying of any fighter, he outlines in some detail the starting, warming up, take-off, propeller governor control, high speed flight, cruising, landing and engine-stopping operations for the P-36. *Canadian Aviation*, May 1941, pages 15–18, 30, 13 illus.

In een aanvallenden Bommenwerper (Aboard an Attacking Bomber). Brief description of the duties of the pilot and every crew member aboard a bombing airplane during an attack. Operations aboard a Sunderland flying boat and a Wellington bomber form the background of the account. *Luchtvaart*, April 22, 1941, pages 142, 143, 2 illus.

National Defense

Production for Defense. Observations on the production program for National Defense by prominent men in the defense program. Major General H. H. Arnold, Chief of the Army Air Corps, writes that "one of our

hardest jobs is to synchronize our training of pilots, navigators and mechanics with the production of airplanes and the construction of bases so as to have them all come out even, at a predetermined time, to form a fighting unit."

According to Undersecretary of War Robert P. Patterson, American air strength is growing and our help is daily adding to Britain's air strength. Secretary of the Navy Frank Knox believes that "the result of the battle of the Atlantic hinges on gaining control of the air as much as it does on the defeat of submarines and surface vessels."

Merill C. Meigs, chief of the aircraft section of the Office of Production Management, considers defense aircraft production "the stiffest job" in our National Defense, because a new technique has had to be devised, new factories have had to be built and new personnel trained. Col. John H. Jouett, president of the Aeronautical Chamber of Commerce, quotes figures on the recent increases in production facilities and notes the new sources of material, the growing numbers of parts suppliers and subcontractors which have been developed to supply unprecedented expansion of National Defense needs. *Aviation*, June 1941, pages 34, 35, 176, 7 illus.

Air Power in the Making. Maj. Gen. George H. Brett. The assistant to the Chief of the U.S. Army Air Corps surveys great progress made since last fall in the military aircraft procurement program. The tripled production of the aviation manufacturing industry in less than a year has put the industry well ahead of schedule. In April of this year, the industry produced 1,427 military aircraft of all types, plus 78 large commercial airline airplanes, whereas the production goal set a year ago called for a production rate of 1,500 military airplanes a month by July of this year.

Explaining how this expansion in production capacity has been achieved the article describes the methods adopted by the government for financing plant expansion and the changes in Army procurement procedure, auditing and contracting which have been made to accelerate deliveries. *Aviation*, June 1941, pages 36, 37, 176, 3 illus.

Naval Aviation

From Walrus to Fulmar. The extremes in the old and the newest types of aircraft used in the British Fleet Air Arm are the Vickers-Armstrong "Walrus," a biplane pusher-type amphibian, and the Fairey "Fulmar," the newest low-wing monoplane Fleet Air Arm Fighter. While the Walrus has a top speed of only 135 m.p.h., its past service has justified its use both on the aircraft carriers and on cruisers.

The Fulmar, on the other hand, is the most complete departure yet from the traditional lines of British Naval aircraft. Although its function is basically that of the single-place land fighter, it carries a navigator whose task it is to keep the airplane located so that they can return to the carrier safely in the event that the wind has drifted them out of sight during combat. *Aeronautics*, June 1941, pages 64, 65, 5 illus.

Gas-Bag Fleet. John Watson. The part that lighter-than-air craft can play in national defense is being studied at the Naval Air Station, Lakehurst, N. J., where crews for semi-rigid and non-rigid lighter-than-air craft are being trained. The advantages of this type of aircraft on patrol and convoy work have become increasingly apparent. A progressive photo series on the inflation of a non-rigid airship is presented with this article. *Popular Science*, July 1941, pages 82–87, 11 illus.

Parachutes

Parachute Troops in Training. A picture-study of the method by which the British train their parachute troops. British parachute technique differs from German and American procedure chiefly in the fact that the British parachutists leave the airplane through a hole in the floor rather than through a door in the side. *The Aeroplane*, May 16, 1941, page 547, 8 illus.

Falling Four Miles at Midnight. Gwynne Johns. The writer relates his experiences while performing a 12,000-ft. delayed parachute drop over England at midnight during the summer of 1938. The article describes the improvised timing equipment used for measuring the drop. *The Aeroplane*, May 2, 1941, pages 491, 492, 4 illus.

Personalities

Back to the Helicopter. Hickman Powell. The story of Igor I. Sikorsky, who after thirty years of designing successful transport airplanes has returned to his first ambition—the construction of a successful helicopter.

At Kiev, Russia, in 1908, Sikorsky at the age of 19 built a helicopter that failed to fly. The success of the Wrights encouraged him to build fixed-wing aircraft. Airplanes of his design have pioneered some of the most important airways in history. This article outlines his career in the United States and in Russia, and explains the operation of his record-breaking VS-300 helicopter. *Popular Science*, July 1941, pages 58–63, 212, 14 illus.

Used Planes Are His Hobby. Marian B. Reeder. Claude Dry, the publisher of the *Used Aircraft Directory*, spends his spare time locating second hand aircraft for pilots who can't afford new ones. This article describes the service and relates some of the amusing incidents which have occurred in the process of locating and disposing of used airplanes. *Air Trails*, June 1941, pages 15, 49, 1 illus.

The Biography of a Pioneer. David Leigh. The persistent desire to fly has influenced the entire career of Hugh Smith, operations manager for American Airlines, and has led him through an interesting chain of events on "his way up"; some of these are recounted in this vignette of the veteran flyer. *Airlanes*, June 1941, pages 5, 21, 2 illus.

He Harnessed a Tornado. Hickman Powell. A biography of Dr. Sanford A Moss, General Electric Co. research engineer, who was instrumental in the development of the gas-driven turbo-supercharger. This article outlines his work in supercharging the Liberty motor during World War I and shows how his device, with only minor changes, aids in making modern high-altitude flying practical. The operation and construction of the turbo-supercharger are explained and some of the incidents during the early tests of the supercharger are related. *Popular Science*, June 1941, pages 66–71, 8 illus.

La Carrière d'un Pionnier: Francois Durafour (The Career of a Pioneer: Francois Durafour). R Dumas. An account of the flying career of the pioneer Swiss pilot who was famous for the first landing on Mont Blanc in 1921. *Schweizer Aero-Revue*, March 1941, pages 29, 30, 31, 7 illus.

Architects of Aeroplanes. Portraits of prominent British and German airplane designers, the products of whose work are playing a prominent part in the present air war. *The Aeroplane*, April 18, 1941, pages 440, 441, 60 illus.

Clement Ader. Sylvia L. England. An account of the flight pioneering of Clement Ader, noted French scientist, who some claim performed a successful flight in 1890. The article contains part of a letter written by him in 1921 in which he told Briand, then French Prime Minister, that a German air invasion would eventually destroy London. *Aeronautics*, May 1941, page 57.

Our New Air Defense Forces. Notes on the series of far-reaching orders affecting the Army Air Corps personnel indicate a trend toward decentralization of air defense under

specialist officers who will have greater latitude in developing defense tactics. Brief biographies of the officers commanding the four Air Defense Forces (formerly the Air Defense Districts), Major General James E. Chaney, Major General Jacob E. Fickle, Major General John F. Curry and Major General Barton K. Yount, are presented. *U.S. Air Services*, May 1941, pages 12, 13, 42, 4 illus.

Cowboy With Wings. William E. Orr. The 25-year flying career of Frank "Spook" Clarke, noted Hollywood stunt pilot. It included such stunts as straddling the fuselage of an airplane in flight while guiding the elevators with his feet. *U.S. Air Services*, May 1941, pages 19, 20, 1 illus.

Colvin, New Head of Guggenheim School. A brief outline of the career of Charles H. Colvin, until recently special assistant to the chief of the Weather Bureau, who will succeed Dr. Alexander Klemin as director of the Daniel Guggenheim School of Aeronautics at New York University this Fall. *U.S. Air Services*, May 1941, page 36.

Col. Clarence M. Young. An outline of the career of Clarence M. Young, who started out to be a lawyer and was side-tracked into aviation by World War I. His career includes flying Caproni bombers over Austria, selling war-surplus airplanes and serving as director of aeronautics for the Department of Commerce in the early days of federally-controlled flying. He is now chief of the Pacific Division of Pan American Airways. *Western Flying*, June 1941, pages 35, 47, 1 illus.

Production

A Study of the Development of Skill During Performance of a Factory Operation. Ralph M. Barnes and J. S. Perkins. Many studies have been concerned with the total time required to accomplish a given task and the influence on time values of various conditions pertaining to a specific operation. This paper, however, is primarily a time study of the elements entering into the performance of an industrial task.

The investigation constitutes a pioneer effort to study the effect of practice in a typical factory operation, conducted under laboratory conditions. The work was undertaken jointly by the Western Electric Company and the University of Iowa. *Transactions of the A.S.M.E.*, May 1941, pages 319–328, 10 illus.

Extruding Aircraft Forgings. James R. Thain. The transition of the aircraft industry from custom to production basis is proving the forerunner both of improved design and of more economical production. Some tool-joint equipment has been retooled to good advantage in fabricating certain important parts for both airplanes and motors, thus relieving the regular drop forging equipment of part of its priority burden.

Some methods of retooling that have proved effective in a large foundry manufacturing parts are described. In the press division, tool-joints and liners are extruded in a 700-ton hydraulic press. The demand for forged blanks to be machined into finned cylinders for air-cooled aircraft motors has been met by extruding cylinders in units long enough to make several machined parts after being sawed to length. Improved hydraulic landing gear struts are extruded by applying tool-joint methods to this part. A few essential facts on extruding operations are noted. *Heat Treating and Forging*, May 1941, pages 219–221, 3 illus.

Jigging the Modern Airframe. A review of the general types of jigs used in the construction of two-spar wings in England, France and Germany. Described as typical of the equipment used for the building of wooden airframe structures are the jigs used in the fabrication of the largest wooden wing ever built—the wing of the four-engined de Havilland Albatross—and the simple angle jigs used on the Airspeed Oxford and the Miles Master trainers.

The Potez semi-permanent steel angle and channel jigs which apply C clamps for holding the work are indicated as the best French method. The Junkers tube and clamp and the Henschel "Meccano," or screwed and bolted channel and standard angle, are typical of the jig that can be taken down and reused for an entirely different airframe. *Aircraft Engineering*, April 1941, pages 107–114, 27 illus.

Features of the Liberator. Production processes and characteristics of the Consolidated B-24 four-engined bomber are described. Attention is given to the Davis airfoil, which on the B-24 is of thinner section than normally used, thus reducing profile drag. The wing design is based on the use of pre-stretched stiffeners, the production of which requires no special plant or extra production processes. The method for their fabrication is explained.

Among various work processes used by Consolidated is the reclamation of Dural scrap from production by melting and casting into slabs and standardized sections which are used extensively in the building of jigs, fixtures and tools. Besides being light in weight, easy to work and a salvage of otherwise waste material, such fixtures expand and contract at the same rate as that of the work. The labor and time-saving uses of such jigs, fixtures and tools are pointed out.

The pouring of molten Cerrobend, or bendaloy, into aluminum tubes before the bending operation, permits sharp bending without collapse of the tube and aids in the proofing of tubes and locating flaws otherwise indetectable. This use of Cerrobend is described. Fuselage and wing assembly are touched upon briefly and some specification and performance figures are given. *Aircraft Production*, May 1941, pages 156–160, 12 illus.

Die Casting of Aircraft Parts. Presented to acquaint British industry with information about the American die casting industry, this article outlines the extensive application of die castings to aircraft to serve as a guide to this branch of foundry engineering in the U.S. Tool and production figures are quoted; typical examples of work done are shown in photographs. The equipment in general use for die casting of aircraft parts is discussed and illustrated by views of floor operations in one such American factory. *Aircraft Production*, May 1941, pages 179–181, 8 illus.

Plywood for Aircraft. An examination of the preparation of veneers, the processes of jointing and bonding and other fabrication procedures employed by Flexo Plywood Industries Ltd., in England. Production methods are described step by step in some detail with considerable attention to the attainment of those structural and property requirements essential to plywood used in aircraft.

While plywood in aircraft is now almost entirely restricted to trainers, the view is taken that it is capable of withstanding first-line conditions of service, as demonstrated in the performance of the Avro Anson which has plywood-covered wings of a type basically similar to those used in the Miles Master and the Airspeed Oxford trainers. *Aircraft Production*, May 1941, pages 161–164, 8 illus.

New Uses of Elektron Sheet. D. B. Winter. An analysis of some of the difficulties inherent in the manipulation of magnesium alloy sheets. New uses of the metal are discussed to show how some of the working handicaps can be overcome and how other advantageous properties of the

metal besides low weight can be exploited.

Magnesium alloys should not be used simply to reduce weight and without regard to the more subtle methods of securing the same result, or to the other useful properties of the metal. A structure incorporating magnesium sheet should be designed specifically for it.

For example, suitably applied, the exceptional welding properties in a material possessing the mechanical strength of "Elektron" AM.503 can be used to great advantage. Distinctly useful is the capacity of this alloy in sheet form to deep draw at elevated temperatures. The use of "Elektron" sheet in a heavier gage than normal with an aluminum alloy, nevertheless reduces weight as a result of the simplification of the internal structure which the greater stiffness makes possible. The extra stability of the metal permits the elimination of a large volume of material employed in rivet and bolt heads and flanges of stiffeners.

Other suggestions are made for more economical and satisfactory techniques for using magnesium alloy sheet, both in design and in production. *Aircraft Production*, May 1941, pages 153–155, 5 illus.

Robert Mitchell Company Makes First Canadian Magnesium Casting. Until now, very little has been done in Canada toward producing magnesium alloy parts. Magnesium is now commercially produced in large quantities at less expense than aluminum and is lighter in weight. Production in commercial quantities of aircraft castings from magnesium alloys is already under way at the Montreal plant of the Robert Mitchell Co., Ltd. *Commercial Aviation*, May 1941, page 94, 1 illus.

Kirksite for Metal Stamps. A special zinc base alloy, known as Kirksite "A," has been developed for use in forming the female dies employed in the production of sheet metal stampings. Made of 99.99 per cent pure zinc, with aluminum, copper and magnesium as alloying ingredients it is said to lower the cost of die maintenance and improve the quality of stampings. The use of the new alloy for stamping, and for blanking and trimming operations is described. *Canadian Aviation*, May 1941, pages 56, 57, 3 illus.

High Strength Aluminum Alloy Extrusions. R. Worsdale. The present tendency of defense production authorities is to discourage the use of structural sections which appear complex in contour or design. The production of more complex sections takes longer, particularly in finishing operations, but it does save the constructor's time in subsequent operations. Furthermore, quantity production of extrusions is not necessarily synonymous with quantity production of aircraft.

Conforming to the need for secrecy on aircraft developments, the writer stops short with the above comment and points to the reliability and utility of structural extrusions, which have been proved under all conditions of service in aircraft. The knowledge derived from this experience is examined to show the great potentialities of extrusions in structural engineering practice generally in the future. *Heat Treating and Forging*, April 1941, pages 183–185, 3 illus.

Wright's Newest Magnesium Foundry. A description of the facilities and operations at the magnesium foundry of Wright Aeronautical Corp. at Fair Lawn, N. J. Devoted solely to the production of aircraft engine castings of magnesium alloys, the plant is built to accommodate line-production methods. At full production, about 650 workers will be employed in turning out at least 150 different castings for parts of all models of the Cyclone and Whirlwind engines. These castings include engine nose sections, supercharger front and rear sections, air intake manifolds, oil sumps, supercharger rear covers, breathers for oil systems and accessory housing covers. Peak production of 210,000 lbs. of finished castings per month is due early in 1942. *Aero Digest*, June 1941, pages 136, 140, 6 illus.

Mass Production in Aircraft Radio. J. H. Harris. The General Manager of Lear Avia, Inc., describes the change-over from custom manufacture to mass production.

In their new plant at Piqua, Ohio, new ideas in personnel training, tooling, layout, assembly and testing have been put into operation. This article describes the plant and its operation, where the application of mass production methods has vastly increased production to meet defense needs without sacrificing performance or durability in the finished product. *Aviation*, June 1941, pages 89, 90, 160, 2 illus.

Manufacture of the Lodge Plug. Making spark plugs to conform to aviation requirements has brought about considerable development apart from change in size. Among such improvements are advances in design which provide for greater heat dispersal and more efficient sparking, and also the introduction of improved insulating materials and methods. One such development is the Lodge Sintox-insulated plug, important feature of which is the new insulating material, "Sintox." It is a ceramic composition of the sintered aluminum oxide class, specifically adapted for high-duty plugs.

This article describes the specialized designs, materials and production technique employed by Lodge Plugs, Ltd., in the manufacture of the Sintox-insulated plug. The fabrication processes involve the use of highly specialized plant and test equipment which are fully described, together with the extensive inspection and testing procedure. Of particular interest is the extent to which female labor has been successfully adapted to many steps of the manufacture requiring the utmost precision. *Aircraft Production*, May 1941, pages 172–176, 16 illus.

Building a Spitfire. An account of large-scale production of Spitfire fighters at a large shadow factory in Britain. The shelters and blast walls used to afford air raid protection without interruption to work are described. Some of the machinery used and the processes of assembly and flight testing are explained in brief. *Flight*, April 10, 1941, pages 271–273, 9 illus.

Fighters in the Making. An account of a visit by a group of British reporters to a plant making Supermarine Spitfire Mark II fighters. Although the account gives little detailed technical information on the structure of the airplane, it reveals that many production tricks have been put into operation to make the work easier for unskilled workers, such as marking all materials of one type in a uniform color for easy identification.

The plant itself is constructed with a light metal roof and the machinery is spaced at wide intervals so that minimum damage can be done by enemy air bombs. A general description of the building procedure is given in this article. *The Aeroplane*, April 11, 1941, pages c1, c2, 9 illus.

Industrious Non-Belligerency. A report, chiefly in pictures, of the types of aircraft being produced in the United States for the R.A.F. An interesting implication is that the Napier *Sabre* engine may be built in the U.S. *The Aeroplane*, May 2, 1941, page 497, 6 illus.

La Tecnica del Estampo (Stamping Technique). A survey of the various uses of hydraulic and drop presses in aircraft manufacturing in the United States. The techniques of leading companies such as Curtiss-Wright, Glenn L. Martin and Douglas are compared. Particular attention is given the Guerin process. *Aeronautica*, March 1941, pages 28, 29, 32 2 illus.

Aviones Plasticos (Plastic Airplanes). A study of the progress made in plasticized wood construction in the United States, beginning with the process used on the Lockheed Vega. Particular mention is made of the Vidal Process and of the Fletcher FBT-2 intermediate trainer and other aircraft built of wood bonded by synthetic resins. *Aeronautica*, March 1941, pages 14, 15, 3 illus.

Estampado con Prensas Hidraulicas (Stamping by Means of Hydraulic Presses). A continuation of a study of the use of stamping in aircraft manufacture, this installment explains the operation of hydraulic equipment in United States aircraft plants. The Guerin process is explained in great detail. *Aeronautica*, April 1941, pages 34, 35, 38, 2 illus.

Konsten att Producera Flygplann (The Skill Which Produces an Airplane). H. G. Tonndorf. A review of the progress made in airplane construction since 1918, describing the change from custom to mass production. The study covers the transition in Germany England and the United States. Special attention is drawn to the part the automotive industry has had in assisting the tooling-up of airplane plants for mass production both in England and the United States. *Flygning*, March 1941, pages 6, 7, 22, 5 illus.

Engineering Considerations in the Application of Automobile Methods to Aircraft Production. Don R. Berlin and Peter F. Rossman. An outline of the various elements necessary in achieving high industrial efficiency in aircraft production. In a series of pictures and captions, the writers show how some of the elements of mass production used in motor car manufacture were applied to airplane construction by the Curtiss-Wright Corporation. The manner in which properly planned and executed tooling contributes toward the fulfillment of the mass-production principle in properly planned operation sequences is discussed, together with simplified jig design, non-fatiguing heights and positions, and other factors. *S.A.E. Journal*, June 1941, pages 218–233, 76 illus.

Progressive Manufacture of Components. The economic control of component production by "progress" methods has become a well-established practice in modern aircraft factories. A tried system for controlling the production of a multiplicity of parts undergoing various operations is here described.

The "batch" system is used for introducing work to the machine shops as a means of preserving the identity of the component through all operations from raw material to the finished product and to permit the tracing of faulty material to the source of supply. The progress department maintains daily records of the location and movement of every batch. Other charts posted daily to preserve constant control over the output of parts are described. *Aircraft Production*, May 1941, pages 184, 185, 5 illus.

Applying Machines to Quantity Production. P. N. Jansen. Airplane construction, according to this article, has not as yet reached the stage where fully automatic machinery can be applied to best advantage. The quantities produced of a single design are still too small. However, the orders are large enough to justify the surrender of the "hand building" methods formerly applied. Taking the Curtiss plant at Buffalo as a typical example, the writer, the factory manager of this unit, states that here a balance between hand and fully automatic operation is being adopted as the best way of achieving accelerated production of the complex modern airplane.

Considering that there are parts of airplanes which lend themselves readily to machine production while others are impossible to build by other than manual methods, it was discovered that between 300 and 400 airplanes of a frozen design were necessary for efficient use of quantity production methods. These operations were divided into two classes; machining and sheet metal work. The article explains the method by which machines are selected and used for these operations, giving examples of production conversion from hand to modern quantity production. *Aviation*, June 1941, pages 46, 47, 180, 182, 13 illus.

Building a Bolt of Lightning. R. A. Von Hake. A survey of the research, engineering, training and factory changes which preceded the quantity production of the Lockheed P-38. The article compares the complexity of the construction of this twin-engined interceptor with that of the structure of a 21-passenger transport. For the single passenger it carries, it requires the same amount of radio, instrument and hydraulic equipment as the transport. This must be compressed into a smaller space, to make room for the complicated and heavy armament required for military use.

The P-38 was the first Lockheed airplane to apply flush riveting over its entire outer surface. The account tells how workers were trained for this technique and how the rapidly expanding Lockheed and Vega organizations are now working together to provide components for the 820-foot assembly line of the Lockheed "Lightning" interceptor. *Aviation*, June 1941, pages 50, 51, 158, 3 illus.

Assembly Line Control. Omer L. Woodson. A study of the planning and operation of the assembly plant of the Bell Aircraft Corp. The new plant has four assembly lines and the task of having materials and completed sub-assemblies arrive at the right time for incorporation into the Airacobra requires careful planning behind the lines. The article explains how the production system has been broken down into 15 key stations at which sub-assemblies arrive and are installed. How the control system is actually applied to synchronized production is outlined. *Aviation*, June 1941, pages 48, 49, 148, 150, 152, 11 illus.

Simplified Production Processes. Contrasting sharply with the employment practice of only a few months ago which demanded an excellent background for factory workers, The Glenn L. Martin Company is now, because of the emergency, taking men into its plant on little more than mechanical inclination. Yet the final product has not suffered in quality or speed of production, due to the unique simplification process evolved by the company to meet the emergency.

A system of fixed steel jigs makes it possible for intelligent workers to perform a workmanlike job of fabrication without long training. Details of how the task of building the airframe for the B-26 bomber was simplified to 32 major sub-assemblies which are constructed to such perfection that they require no cutting or trimming to fit on the assembly line, are given. *Aviation*, June 1941, pages 52, 53, 188, 5 illus.

Big Boats and Bombers from the Same Factory. Edgar N. Gott. Consolidated Aircraft Corp. has solved the problem of producing three types of large aircraft, the four-engined PB2Y-2 flying boat, the twin-engined PBY and the B-24 four-motored landplane bomber by operating their plant like a Hollywood movie lot. It was designed so that the operations in any building can be converted from one model of production to another. This was accomplished by such expedients as using clamped pipe joints instead of threaded or welded ones, installing all light and ventilating systems above the monorails and building doors of generous dimensions to accommodate almost any future size of aircraft.

Consolidated's 50-hour week and 20-hour day permit a wider "spreading out" of skilled labor and also give a two-day week-end and in-

creased opportunities for overtime.

Figures are given on the new Consolidated assembly plants being built at Tulsa and Fort Worth which will build B-24 bombers from parts built by the new Ford plant at Ypsilanti, Michigan. *Aviation*, June 1941, pages 56, 57, 4 illus.

Production for America's Preparedness and Democracy's Preservation. F. W. Conant. A survey of Douglas Aircraft Company's part in building aircraft for defense, this article outlines the company's expansion at their home plant at Santa Monica, their new factory at Long Beach, now rapidly nearing completion, and their part in the operation of the Government owned assembly plant at Tulsa, Oklahoma.

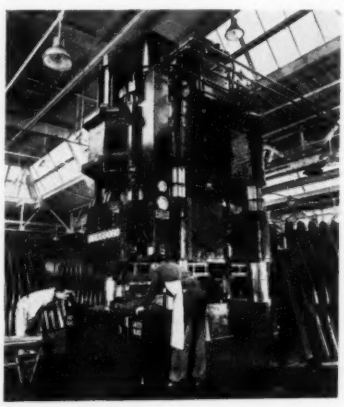
At Santa Monica, the employment at present exceeds 50,000 and the annual payroll tops $90,000,000. A-20 attack bombers, SBD dive bombers, DB-7 bombers and C-47 military transports are rolling off the production lines for both the U.S. and Britain, while the recently completed B-19, the 82-ton bomber, stands ready as a prototype for a family of aircraft able to strike at the enemy anywhere in the hemisphere.

The Tulsa assembly plant, now well on its way to completion, will operate under a unique partnership between the Government, Consolidated Aircraft, Douglas, the Ford Motor Company and a score of subcontractors. This article describes the new plant, explains how Consolidated and Douglas will provide the engineering skill and production men, Ford the sub-assemblies, while smaller parts will be built by such groups as Murray Body, Briggs Manufacturing, Pullman-Standard Car, Fleetwings and McDonnel Aircraft Co.

The production methods at the new Long Beach plant and the mass application of the Guerin process and the new 100-degree flush riveting system developed by Douglas and recently released for national use are also explained. *Aviation*, June 1941, pages 58, 59, 154, 156, 5 illus.

Getting 'em into the Blue Ahead of Schedule. R. A. Lawson. The Works Manager of the Vultee Field Division of Vultee Aircraft, Inc., explains some of the plant philosophy and production methods which have permitted Vultee to complete its recently finished contract for 300 BT-13 trainers far ahead of schedule. The basic reason for this record, according to the article, is the theory that all acceleration must come from the workers, not from machinery or methods. It is the development of team play in the plant which has permitted the speed-up. This, naturally has been augmented by such "streamlining" of procedure as orders directly from blue-prints which eliminated the loss of almost a year before a prototype could be built and the minor problems in its production worked out.

The application of new ideas developed for production acceleration, such as the arc welding of steel tubing, rotary platen hydraulic presses, and design to use forgings and castings that can be finished by semi and fully automatic machinery are explained. A schematic drawing of the production system showing how raw material enters the plant, flows to departments, how the production is synchronized so that sub-assemblies arrive at the assembly line to be installed without loss of time is also provided. *Aviation*, June 1941, 64, 65, 162, 5 illus.



A 2,000 ton press, shaping segments of hollow steel blades for electrical propellers, at the Curtiss-Wright Propeller Division's plant at Caldwell, N. J.

Sperry Lets George Do It. Carl Norcross. Sub-contractors are now turning out a quarter million machine-hours of work per month for Sperry. Frequently a third of the parts that go into instruments and elevation finders are made outside the plant. The system for educating small gear firms, sewing machine factories and cream separator builders to build parts to close tolerances is explained in this article. It began with a survey to locate the plants, educational orders to give the sub-contractor an idea of what was expected of him, and finally, supervision, advice, aid in training proper help, machine loading charts and rigid inspection at the sub-contractor's shop. *Aviation*, June 1941, pages 76, 77, 168, 170, 2 illus.

248 Factories Build the Flying Fortress. In eighty cities, scattered throughout the United States, 248 separate firms build parts that eventually find their way into the four-engined Boeing B-17 bomber. The percentage of parts built outside the plant has risen from three to thirty per cent since last year.

This article outlines the function of Boeing's Purchasing and Material Control Department which sets up the system of "farming out" parts, provides the sub-contractors with engineering aid, sends representatives to the sub-contractors, inspects the product and synchronizes the production of the sub-contractors with that of the main plant in Seattle. *Aviation*, June 1941, pages 74, 75, 176, 186, 10 illus.

What Next in Aircraft Expansion? Leslie E. Neville. The editor of *Aviation* renders an appraisal of current expansion in the nation's aircraft building facilities and a forecast of what future expansion and postwar procedure are likely to be. Figures are provided on the three-fold increase in output which has been accomplished since last year.

The Knudsen Plan for bomber procurement is explained. It harnesses together the production facilities of Ford, Consolidated and Douglas, aided by automobile sub-contractors, for the production of Consolidated B-24-D heavy four-engined bombers. Similar industrial alliances have been conceived under the plan for the assembling of North American B-25 twin-engined bombers at a government-owned assembly plant operated by North American at Kansas City from sub-assemblies built by General Motors and for Martin B-26 medium bombers assembled at a Martin operated government assembly plant sub-assemblies built by Chrysler, Goodyear and Hudson.

Wright and Pratt & Whitney engines are being built under license by General Motors, Ford and Studebaker, while Nash-Kelvinator will soon be turning out numbers of Hamilton Propeller parts. The survey names many of the sub-contractors and purveyors and contains a tabulated list of the plants which have undergone expansion. Their location, area, personnel, expansion cost and in some cases their rate of production are given. *Aviation*, June 1941, pages 42, 43, 172, 174, 176, 2 illus.

Propellers

Airscrew Blade Roots and their Effect on Performance. F. C. Lynam. A study of the effect of proper blade root design on the cooling of

radial engines and their performance at top speeds. Comparisons are made between the efficiency of fixed pitch wooden propellers with properly designed spinners and metal propellers with long circular roots designed for structural and strength considerations.

The introduction of variable-pitch propellers made the solutions of those problems arrived at for fixed pitch wooden propellers of decreased value. This article compares the American solution to the new problem, the use of aerodynamic cuffs over the blade roots, with the British solution, the use of aerodynamically shaped blade roots. *Aeronautics*, June 1941, pages 48–50, 7 illus.

A Four-Bladed Airscrew. Description of the new four-bladed Rotol electrically controlled variable-pitch propeller, designed to accommodate the larger power plants now being contemplated in England. *Aeronautics*. June 1941, page 47, 1 illus. Also *The Aeroplane*, May 16, 1941, page 558.

Fatigue Testing by Strainmeter. H. N. Charles. An explanation of the use of the strainmeter, as employed by Rotol Airscrews Ltd., for measuring the vibration stresses in propeller blades. Small electrical resistances are cemented to the blade. Through a sensitive galvanometer, which in turn is hooked to a mirror, the vibrations are recorded on motion picture film.

The Rotol company's equipment is mounted in a truck so that it can be taken directly to where the testing is needed rather than have the propeller and frequently the airplane brought to the plant. *The Aeroplane*, March 14, 1941, 315, 316, 6 illus.

The Junkers Constant-Speed Unit. James Hay Stevens. An addition to a recent report on the Junkers constant-speed propeller, this article contains a description of the construction and operation of its governor unit. *Aircraft Engineering*, April 1941, pages 95, 96, 101, 4 illus.

Rotating Wing Aircraft

Future of the Helicopter. Igor I. Sikorsky. The designer of the VS-300 helicopter, long a proponent of this type of aircraft, examines the future potentialities of this kind of flight. Mr. Sikorsky's work on helicopters began in 1909, was at times discontinued, then resumed, and finally culminated in the VS-300 which recently established a world's record for helicopters by hovering for more than an hour and a half above an area of less than half an acre.

The writer believes that "the success of the VS-300 leaves no doubt that the direct lift machine is here." He reviews the many types of service it can render in civil, government and military aviation. The helicopter in general is not to be expected to replace or duplicate the service of the vast majority of military or commercial airplanes. Its place is to solve a transportation problem not yet met by any other means.

The ability of the helicopter to slow down safely to 30, 15 or 5 m.p.h. affords the same maneuverability and safety as the automobile, where darkness or poor visibility encumber the fixed-wing airplane. The facility with which the helicopter may render service under most difficult circumstances is augmented by its ability to hover directly over one spot for indefinite periods of time. The potentialities of this kind of flight are no longer a question of theoretical speculation; they have been proved by the repeatedly successful performance of the purely experimental VS-300. It is now possible to look forward to the rapid and final improvements that will bring this type of transportation to the world. *Aero Digest*, June 1941, pages 120, 121, 1 illus.

Hubschrauber oder Autogiro? (Helicopter or Autogiro?). Willy Ley. A comparison between the Vought-Sikorsky VS-300 helicopter and the Kellett KD 18 Autogiro, giving the construction, power and performance characteristics of each type. The relative advantages of both types are discussed. *Schweizer Aero-Revue*, April 1941, pages 11, 12, 3 illus.

Recent Air Corps Developments in Rotating Wing Aircraft. H. F. Gregory. Some two years ago, Army tests were thought to indicate that the autogiro might develop into an extremely useful military instrument, particularly adapted to certain observation and other needs in Army cooperation. Since then, however, the Army procured seven autogiros and conducted extended service tests with the Cavalry, Field Artillery, Coast Artillery and Infantry. Results of these tests indicated that the type of autogiro then used was not suitable to military needs, chiefly because of tricky handling characteristics, insufficient performance with reference to landing and take-off characteristics, excess pilot fatigue in flying, and insufficient load carrying capacity.

Resultant recommendations were that a high-performance low-speed airplane be developed in this country and that the autogiro be developed with special emphasis on improvement of handling and performance, lessening of pilot fatigue and increasing load-carrying capacity. The improvements undertaken by the Army after much development work are outlined in this article. They include an improved rotor blade, accelerated take-off mechanism, an improved rotor starter, direct take-off, a flexible pylon mount, the installation of larger engine and constant speed controllable pitch propeller, and flexible landing gear. These improvements were made on the YG-1B which has been redesignated as the Army XR-2, and is scheduled for delivery in the early summer this year.

Further Army experiments with feathering control system and with the development of the helicopter are briefly noted. *Journal of the Aeronautical Sciences*, June 1941, pages 331–333.

Stress Analysis

The Proportioning of Aircraft Frameworks. N. J. Hoff. A simple rigorous method is presented for the calculation of the instability of frameworks. The method is based on convergence properties of the Hardy Cross procedure proved by the author in the January issue of the *Journal of the Aeronautical Sciences*. By the calculation suggested, the uncertainties involved in an arbitray choice of the end-fixity factors (or restraint coefficients) are entirely eliminated. In addition, a check of the stresses caused by side loads is obtained simultaneously. Suggestions are made for the preliminary proportioning of the bars. *Journal of the Aeronautical Sciences*, June 1941, pages 319–324, 6 illus.

Buckling Between Rivets. J. Prescott. A mathematical analysis of the significance of buckling between rivets of thin sheet attached to a stiffener. The paper concludes that the buckling is not the cause of failure, merely the sign of failure of the entire structure to which both sheet and stiffener contributed. *Aircraft Engineering*, April 1941, page 104, 1 illus.

Tapered Spar Frames. H. M. J. Kittelsen. An approximate method for the determination of the stresses in, and the deflections of a fuselage. The method and formulas outlined in the article are applicable to any shape of fuselage, but an elliptical type is used as an example. *Aircraft Engineering*, April 1941, pages 90–94.

Ausrollstrecke, Bremsbeanspruchung und Überschlagmöglichkeit beim Landen (Length of Landing Run, Braking Stress, and Possibility of Ground Looping During Landing). G. Mathias and K. Schaaff. Report of an investigation to determine on what the length of landing run of an airplane depends; what stress the wheel brakes must carry in order to stop the airplane at a defined distance; and under what conditions during the landing run the airplane might make a ground loop. *Luftfahrtforschung*, March 1941, pages 70–76, 9 illus.

Equiareal Pattern of Stress Trajectories in Plane Plastic Strain. Michael A. Sadowsky. In theoretical plasticity, all work so far has made use of slip lines as a frame of reference. In this paper, stress trajectories are used instead, and results of theoretical interest and practical applicability are obtained. The equiareal property of stress trajectories as derived in this report can be readily used to evaluate photographs of slip lines in plasticity with a higher degree of accuracy and reliability than formerly. The analytical method can be applied to the equiareal pattern formed by stress trajectories and formulas for stresses are obtained. An example referring to radial flow adequately illustrates the general equiareal property. *Journal of Applied Mechanics*, June 1941, pages A-74 to A-76, 6 illus.

The Buckling of Thin Cylindrical Shells Under Axial Compression. Theodore von Kármán and Hsue-shen Tsien. Previous theoretical investigations on the buckling of thin cylindrical shells under axial compression usually assume that all the deflections involved in the buckling process are infinitesimally small and thus simplify the calculation by neglecting second order quantities. The resulting buckling load is 3 to 4 times too high when compared with experimental data. In this paper, the deflections of shell are taken to be "large" and second order quantities are retained. The buckling load thus obtained checks quite closely with the experimental value. Furthermore, the observed diamond-shaped wave pattern of the surface of buckled shell is also indicated by the new theory. Therefore the discrepancy between experiments and previous theory is explained.

In the last part of the paper, the influence of the elasticity of the testing machine on the buckling behavior of thin shells is discussed. This fact is offered as a possible explanation of the wide scatter of test data from different sources. *Journal of the Aeronautical Sciences*, June 1941, pages 303–312, 8 illus.

Tafel Einiger Knickbiegefälle (Table of Some Cases of Buckling Due to Bending). J. Cassens. In order to make tables for the calculation of buckling due to bending more comprehensible, the methods are discussed by which the cases are calculated. The importance of the buckling modulus in buckling due to bending is mentioned. Tables follow from which may be found the values for moments, deflections and tangents in problems of buckling due to bending. *Luftfahrtforschung*, March 1941, pages 86–94, 3 illus.

Untersuchungen zur Erfassung des Biegungs- bzw. Beulungseinflusses bei Spannungsmessungen an nur einseitig zugänglichen Schalenkonstruktionen (Investigations on the Effect of Bending and Buckling During the Stress Analysis of Stressed Skin Constructions Which Are Accessible on One Side Only). A. Dose. Expansion measurements made on thin-walled shell constructions, one side of which is covered, often lead to results which are very much distorted due to buckling phenomena caused by expansion as a result of bending. These phenomena occur easily on shell constructions. This report shows how, by means of a relatively simple method, almost correct values may be calculated for stress in the center layer. *Luftfahrtforschung*, March 1941, pages 95–101, 14 illus.

Über den Einfluss von Bohrungen mit Gewinden und Kerbverzahnungen auf die Zeit- und Dauerfestigkeit von Leichtmetall-Flachstaben (On the Effect of Threaded or Fluted Holes on Endurance and Fatigue Strength of Light Metal Plates). H. Burnheim, V.D.I. The purpose of the study reported was to determine the notching sensitiveness numbers of light metal plates with cylindrical holes at initial tensile stress. Special interest was paid to the variation of notching effect numbers with the vibration numbers. The investigations were extended to corresponding plates with holes under load (fish plates). *Luftfahrtforschung*, March 1941, pages 102–106, 17 illus.

Über die Minimalsatze der Elastizitätstheorie (On Minimum Statements of the Theory of Elasticity). Constantin Weber. In this report the minimum statements of the theory of elasticity are deduced on a very extensive basis. Their applications for the determination of elastic constants are explained following the introduction of certain limitations. *Z.A.M.M.*, February 1941, pages 32–42, 8 illus.

Das Knicken schwerer Gestänge (The Buckling of Heavy Rods). Fr. A. Willers. In the determination of the buckling load of a rod, its own weight is usually disregarded. Consideration of this weight in the investigation of the buckling of long rods, *e.g.*, boring rods, is important. Using the well-known minimum principle, an equation and marginal conditions are obtained. Integration leads to the Bessel and Lommel functions from the asymptotic representation of which the buckling force for very long rods can be found. *Z.A.M.M.*, February 1941, pages 43–51, 2 illus.

Testing Equipment

Drop Testing of Landing Gear. Test equipment recently developed by Rubery Owen Messier, Ltd., is presented in a discussion of its design and applications. A drop testing machine simulates those conditions of landing that are most important in evaluating the performance of equipment being tested.

Limitations of drop testing are noted in conjunction with a description of types of drop test machines hitherto in use. The design, actuation and performance of the new type test equipment are described with an explanation of test recordings and the interpretation of them. *Aircraft Production*, May 1941, pages 165, 166, 5 illus.

Plane Test Lab. Used for Inspection. A commentary on the inspection and testing laboratory at the Bell Aircraft plant in Buffalo. Besides testing sample parts and materials in every conceivable manner, the laboratory conducts research work. The testing devices and equipment used are briefly described; the facilities of the X-ray division in particular are noted. *Canadian Aviation*, May 1941, pages 50, 52, 7 illus.

Seeing It through. E. J. Tunnicliffe. This article on aircraft component inspection by X-ray describes the fundamental requirements of the apparatus employed. Safety requirements, oil-immersed generators, radiography, control, the generator, X-ray tubes and the target area are discussed. The use of radiography and fluoroscopy is compared as to the specific advantages of each. *Flight*, May 8, 1941, pages 328-b to 328-e, 8 illus.

Tools and Equipment

Modern Machine Tools. Descriptions and illustrations of recent British developments in machine tool equipment for the aircraft factory. Among these are turning, grinding, sawing, precision grinding, vertical milling, jig boring, cutter grinding and centerless grinding machinery. *Aircraft Production*, May 1941, pages 167–170, 10 illus.

Tool Making and Tool Inspection. A toolroom foreman in a leading British aircraft factory explains his conception of the correct initial procedure in toolmaking, beginning with the prototype. The program briefly outlined gives particular consideration to accurate and inexpensive tooling as a curb on the heavy cost of retooling for inevitable modifications in design. *Aircraft Production*, May 1941, page 176, 2 illus.

Pneumatic Tools. Part I. This series of articles is presented as an aid to the many new users of pneumatic tools in the aircraft industry and deals with percussive hammers and rotating tools, such as drills and grinders, furnishing explanations of how these tools work. This initial article is on the general layout of compressed air mains and accessories; it discusses the best method of arranging pipework from the compressor and receiver. *Aircraft Production*, May 1941, page 171, 2 illus.

Shop Equipment and Small Tools. A number of new developments to aid efficient production are described and illustrated. Among these are a portable works microscope, an electric pencil, gaging equipment, an optical protractor, grinding carbide tools and plant protection units. *Aircraft Production*, May 1941, pages 182, 183, 6 illus.

Construction of Heating Coils for Induction Surface Hardening. Part IV. George Babat. Concluding article in a series discussing various types of heating coils for induction surface hardening. Methods and applications are described for designing heating coils best suited to various functions. *Heat Treating and Forging*, April 1941, pages 192–194, 4 illus.

Designing for Machinability. Part IV. Milling. James E. Thompson. The concluding article in this series by Vultee Aircraft's specification engineer describes the design, function and operation of vertical and horizontal milling machines and various cutting edges. As in the previous articles, the discussion undertakes to afford a familiarity with the machine to facilitate aircraft and part design practice in simplifying the machining job by designing for machinability. *Aero Digest*, June 1941, pages 127, 128, 131, 132, 134, 23 illus.

Warfare

Overrun Attack Tactics. W. J. D. Allan. Successful fighter tactics have resulted, this writer states, in the German bombers being equipped with heavier armor and power-driven turrets. To overcome this, a new type of twin-engined fighter is suggested, equipped with light cannon firing forward and a power driven turret capable of firing astern between the airplane's two tail booms. The attack technique suggested requires that the craft dive on the bomber below and shed its surplus speed by means of an air brake, slowing down to give the rear gunner a good shot at the pilot's cockpit. *Aeronautics*, May 1941, page 29, 3 illus.

Three Months' Air Losses. A comparison and analysis of British and enemy air losses during the first three months of 1941. Graphs shown give a sharp view of comparative losses. The Italian air collapse is particularly evident. *Flight*, April 10 1941, page 270, 2 illus.

Retaliatory Raiding. An examination of the two large-scale German raids on London which occurred on April 16th and 19th. These attacks were believed to be in retaliation for R.A.F. attacks on Berlin on April 10. The six-day gap led experts to conclude that it took the *Luftwaffe*'s staff six days to get the large-scale bombing organized, as the weather was ideal during the six intervening days.

In discussing the defense and attack tactics, the article points out the necessity for R.A.F. bombers taking off during the raids to bomb German air bases. This disorganizes ground facilities and prevents repeated bombings by crews who have already sized up their objectives in England. *Aeronautics*, June 1941, page 79.

Hit Where It Hurts Most. E. Sykes. This article suggests a method for selecting targets for the R.A.F. to bomb in Germany on the basis of the greatest paralyzing effect per bomb. The objectives are chosen by breaking down each division of the German war machine into areas or industries supplying important materials or services.

For example, for building and continued operation, the airplane requires the steelworks, aluminum works, the engine plant, air-frame factory, oil refinery and finally, the landing field. To interrupt operations, only one link in the chain would have to be broken.

In selecting the best target, consideration should be given the places in Germany providing materials for tanks, ships and aircraft. Steel mills and oil plants would be the most obvious answer. Yet destruction of these points could be offset by reserves of both oil and metal in stocks sufficient to cover the period needed to repair the mills and refineries. The one thing of prime importance to war industry which cannot be imported or stored in any quantity is electricity. Therefore, the writer suggests the continuous bombing of the power generating plants of the Reich. *The Aeroplane*, May 16, 1941, pages 555, 556, 5 illus.

A Job for Fighters. Roger Tennant. It is stated that the Fighter Command of the R.A.F. has dealt so effectively with German daylight bombers that, with the exception of occasional hit-and-run daylight raiders, most of the enemy action has been transferred to night activity. As long as the blackout continues, the fighters are of little use at night, except when the moon is up.

The article suggests that good use can be made of the Fighter Command's airplanes by equipping them with bomb racks to carry 500 to 1,000 lbs. of bombs. This would permit the use of the equipment and personnel which are now lying idle. *The Aeroplane*, May 9, 1941, pages 518, 520, 4 illus.

The War in the Air. The rôle of the R.A.F and the Fleet Air Force in the Battle of Cape Matapan in the Ionian Sea is described in this account of the British victory. Scattered reports of other British air war activities are included. *Flight*, April 10, 1941, pages 267–269, 3 illus.

Our Air Army. A series of photographs showing Britain's new "Paratroops" in training provides one of the first picture stories of an air branch which is comparatively new in the British forces. First indication of their use came with an announcement of their employment early this year in southern Italy. *Flight*, May 15, 1941, pages 344, 344-a, 8 illus.

Welding

Atomic Hydrogen Welding in Aircraft Production. R. Smallman-Tew. An examination of atomic hydrogen welding as applied to aircraft production and an explanation of the development of the process for the production of weldings as replacements of forgings. *Transactions of the Institute of Welding*, pages 22–28, 10 illus.

The Arc Welding of High Tensile Alloy Steels. A research report presented in three separate papers before the Institute of Welding (British). These papers are individually reviewed below. *Transactions of the Institute of Welding*, January 1941, pages 3–22.

Part I. The Cracking Problem with Special Reference to Thermal Characteristics. E. C. Rollason. The problem of welding high tensile steels lies in preventing hot cracks in the weld and cold cracks in the hardened base plates. This paper offers thermal data for two steels.—6 per cent Cr, ½ per cent Mo and 3½ per cent Ni-Cr-Mo. The brittle constituents, in which cracks usually occur on welding, form at 200° to 140°C. for Ni-Cr-Mo steel and at 350° to 250°C. for Cr-Mo steel. Suggestions are made on the use of thermal data.

Welding tests were made in order to induce cracking in the plates and the results show considerable difficulty with cracking in the weld metal. Preheating of samples is beneficial as regards the tendency to cracking. General considerations of the problem are reviewed. *Transactions of the Institute of Welding*, January 1941, pages 3–9, 13 illus.

Part II. Base Metal Cracking. E. C. Rollason and A. H. Cottrell. Welding tests were made on a 4.S.11 type of Ni-Cr-Mo steel and 6 per cent Cr-Mo steel, using high tensile and special 18–8 austenitic steel electrodes. The measurement of the temperature at which base metal cracks occur was made by means of extensometer readings of the movements of the plates immediately after welding. Cracking occurred within the range of 35° to 98°C. The effects on cracking of preheating and delayed cooling were studied.

The work was carried out on alloy steels which harden when cooled at moderate speeds from elevated temperatures, and the object of the study was concerned with the problem of cracking in the heat-disturbed zone of the base plate. *Transactions of the Institute of Welding*, January 1941, pages 9–16, 16 illus.

Part III. The Effect of Delayed Cooling on Properties of Martensite; and a Magnetic Test for Determining the Transformation Temperature. A. H. Cottrell, K. Winterton and P. D. Crowther. A report of tests conducted to examine the supposition that delayed cooling has the effect of making the steel more resistant to cracking by increasing its toughness.

Mechanical tests showed that delayed cooling treatment gives an improvement in the toughness of the martensitic structure of steel and imparts to it a capacity for plastic deformation. Much of the improvement is obtained within the first ten minutes of delayed cooling, and a temperature of 160°C. appears to give the best results for tempering times of this order. Delayed cooling experiments showed that cracking is reduced very considerably when delaying treatments at 100°C. for ten to twenty minues are applied. *Transactions of the Institute of Welding*, January 1941, pages 17–21, 26 illus.

Design for Spotwelding Structures. Charles W. Dodge. The increased use of spotwelding of aluminum alloys at Vought-Sikorsky has developed a new design procedure to accommodate the technique. This article explains not only the theory of spotwelding and the three types of equipment commonly used, but lists the combinations of alloys that can be welded successfully.

Because of the nature of spotwelding, all structures joined by this method must be designed so that both electrodes can reach the desired area without obstruction. The changes from riveting design necessary to accomplish this, the ratio of thicknesses that can be welded and the diameter of spotwelds in various alloys are given. Shop control methods and the procedure in testing spotwelds are also outlined. *Aviation*, June 1941, pages 62, 63, 184, 186, 229, 18 illus.

Miscellaneous

Art and the Air Force. An unnamed art critic, in discussing the paintings of aircraft in action, points out that photographic accuracy is not necessary for good presentation. Technical accuracy, he claims, must be implied but need not be stated. The writer makes a comparison between the work of Paul Nash who tries to express the emotional side of the modern airplane, and Roy Nockold whose paintings are not only technically correct but incorporate a feeling of the air. *Aeronautics*, May 1941, pages 30–34, 9 illus.

Army Gadget Lab. Douglas L. Ingells. In addition to airplanes and engines, the Army Air Corps Materiel Division at Wright Field, Dayton, Ohio, tests the hundreds of items which are necessary for the upkeep of the Air Force, such as parachutes, flying suits, tanks, guns, cameras, etc. This article describes the work of this division, outlining some of the tests applied to materials before they are accepted for army use, and the constant research which is carried on to improve existing equipment and materials. *Air Trails*, June 1941, pages 12, 13, 44, 12 illus.

Britain Calling. F. D. B. A British correspondent, touching lightly on the state of Britain's air war efforts, comments favorably on American aircraft types in service overseas, finding insufficient armament "the main snag." *Commercial Aviation*, May 1941, pages 85, 87, 97, 110, 2 illus.

Presses Used in Metal Reclamation. A special conservation plant is used by the Buick Motor division of General Motors to handle the collection and reclamation of metals made waste in the process of manufacturing. Hundreds of pieces of equipment are involved in the work of salvaging, which last year totaled more than 122,000 tons of various metals, including aluminum, lead, tin, zinc, copper, antimony and nickel—all of which are defense priority materials. A 100 per cent recovery was achieved in these metals.

The sources of salvage, assorting and classification, and the reclamation process are briefly described. Hydraulic presses are used extensively in conservation operations to mutilate parts, crack castings to remove bolts, break up culled sub-assemblies, press out bushings, etc. *Heat Treating and Forging*, May 1941, pages 230, 231, 1 illus.

Electric Energy in Aircraft. Assen Jordanoff. The author of the book, *Your Wings*, explains in this article some of the fundamentals of the electrical systems used in aircraft. *Canadian Aviation*, pages 29, 30, 3 illus.

Improvements in Flexible Hose Lines and Fittings. Peter F. Hurst. Some of the problems involved in the use of flexible hose lines and fittings on aircraft are pointed out in this article, which describes a new type of hose and fitting being widely adopted for both military and civil aviation.

It is suggested that ideal flexible hose line requires these considerations: flexibility, universal use, pressure range, weight, resistance to flow and ease of assembly. The manner in which the Aeroquip product meets these requirements is explained. *Aero Digest*, June 1941, page 166, 2 illus.

Pilot's Kit, Then and Now. C. D. Curran. The British pilot's dress and service apparel of 1916 and the present are compared as to material, style, comfort and usefulness. While the Khaki whipcord of the Royal Flying Corps with its Sam Brown belt and high-topped boots may have worn better than the modern blue-grey barathea, it had neither the style nor the comfort of the latest R.A.F. outfit.

As to flying gear, while the old-fashioned fleece-lined whipcord furnished sufficient protection for low-altitude flying, the altitude and temperature at which modern fighting takes place require special clothing, properly insulated and electrically heated. *Aeronautics*, June 1941, pages 97, 98, 6 illus.

(Continued on page 57)

Machine Tool Equipment

It is claimed that this second edition of an English work covers the drawing and design of equipment for practically all modern machine tools. The author, however, rightfully reminds the reader that there exists such a diversity of opinion on some points that any method or design mentioned in the book is not necessarily mandatory.

In preparing this revision, the opportunity was taken to introduce a chapter on materials, a subject very closely related to jig, tool and fixture design. Another new feature is the inclusion of a series of plates illustrating recent practice, which should prove instructive.

Specialized subjects such as bakelite molding and die-casting mold designing were omitted purposely as requiring a volume by themselves. The author has tried to deal with the subject in a simple manner, covering at the same time as wide a field as possible—the beginner, as well as the man in the shop, has been considered.

The author took into account the possibility of the book being used by persons not conversant with the rules of machine drawing, and therefore deals with these rules in his first chapter. The succeeding chapters in order discuss: first considerations in the design of jigs, tools and fixtures; drill jigs; milling fixtures; chucks and turning equipment; cutters, screwing equipment, gages, press tools; Brown and Sharp cams; special equipment; jig and tool office procedure; standardization; magnetic and pneumatic gripping. The work concludes with a chapter on materials. The entire book is well illustrated and adequately indexed; it should be useful to any machine shop.

Jigs, Tools and Fixtures, by Philip Gates; 2nd edition, Chemical Publishing Company, Inc., Brookyln, N. Y., 1941; 209 pages, $4.00.

The What-and-How of Plastics

Addressed to "the industrialists of the world," this book has been written by unidentified authors to impress upon industry as a whole the possibilities as well as the limitations of plastic materials. The astonishingly rapid growth in a brief twenty years of an industry, the elements of which, paradoxically, are traceable for centuries back, has led to a confusion of ideas about plastics—misconceptions which this book seeks to correct.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

It is said that the secret with regard to plastics lies first in the fact that they are easily molded into complicated shapes and secondly that they possess many properties presenting outstanding advantages for many purposes. Opening chapters of this book review the various types of thermo-plastic and thermosetting resins, molding and fabrication technique, and engineering and chemical machinery and plant. Sections follow on the uses of plastics in the electrical, aeronautical, automobile, textile, building and other industries. Throughout the book the material is informative and the style interesting.

To those in aviation, the chapters on aircraft construction, synthetic glues and synthetic rubber offer especial interest. "Robbed of all sensationalism, the rôle of plastics in aircraft construction is an important one," the authors find. Plastics are being exploited for many unstressed and lightly stressed parts now made of light alloys, and they offer "distinct promise" even for certain stressed parts. The mechanical strength and costs of plastics in aircraft construction are compared to aluminum alloys.

Cellulose acetate, acrylic resin sheet, impregnated wood, special reinforced synthetic resins, standard molding powders and synthetic glues and rubber are treated as to their comparative properties and applications in aircraft construction and parts and accessory manufacture. The book contains a number of plates and is a useful general survey of a field of growing importance.

Plastics in Industry, by "Plastes"; Chemical Publishing Company, Inc., Brooklyn, N. Y., 1941; 241 pages, $5.00.

Thermodynamics for Students

This second edition of a text previously printed in August 1937, is intended primarily for students in engineering colleges in this country, where courses in thermodynamics usually are taken during the second and third years of a four-year curriculum. It assumes a preceding knowledge of the Calculus, and that it will be followed up by "applicational" or "professional" courses such as power plants, internal combustion engines, etc. The author, H. A. Everett, is head of the Department of Mechanical Engineering of the Pennsylvania State College.

In his own words: "A work of this sort presents little that is new; it consists mainly of the author's method of presenting the classical and neo-classical data."

The acceptance of the new spectroscopic data on the specific heats of gases at high temperatures, emphasis on the application of the continuous flow principle to heat engines and a revision of the approach to the consideration of fluid flow constitute the major changes in this new edition. The order of subjects parallels closely the author's classroom presentation as developed over several decades of teaching. Considerable stress is laid on the kinetic theory explanation of heat. Following this, one chapter is devoted to the fundamental concepts vital to thermodynamic thinking. Next comes the application of the perfect gas and the consideration of actual engineering devices which use gases. Vapors are considered a narrowed portion of the gaseous phase and thus, together with practical applications, logically follow gases. A very brief and simplified chapter is devoted to the general mathematical relations.

Special attention has been directed in the chapter dealing with gases to the departure of actual gases from the perfect gas and the charts which evaluate the change in the gas constant are original.

Steam tables and tables of natural logarithms follow the last chapter. There is also an appended section on thermodynamic problems which are correlated to the text, chapter by chapter.

Thermodynamics, 2nd Edition, by H. A. Everett; D. Van Nostrand Company, Inc., New York, 1941; 466 pages, $3.75.

Quick Easy Way to Find

Answers to AVIATION QUESTIONS

Endorsed, Used, and Recommended by the Entire Aviation Industry

Baughman's AVIATION DICTIONARY and Reference Guide, just off the press, answers every aviation question; clearly and accurately defines terms and phrases used in all branches of aviation. Contains also a directory of manufacturers, airlines, airports, etc. Absolutely indispensable. Here's a book that you really need. Sold on Money Back Guarantee. Order yours today.

New Text Books Simplify Aviation Subjects

Write now for information about new text books on important aviation subjects. Each is a complete course—clear, concise, complete. Written by outstanding aviation authorities, by men in the industry, to prepare students for the Aviation Industry. New Books include "Stress Analysis," "Factory Inspectors' Manual," "Aircraft Template Development," "Factory Mechanics' Manual," "Lofting" and "Blue Print Reading." Use coupon below for further data.

Use Coupon Below

AERO PUBLISHERS, INC.
120 NORTH CENTRAL AVE.
GLENDALE, CALIF.

( ) I am enclosing $5.00 check (or money order). Please send me a copy of Baughman's Aviation Dictionary & Reference Guide. If not completely satisfied, my money will be refunded.

( ) Please send me information about new text books.

Name.....

Address.....

City.....State.....

Prevention of Fatigue of Metals

A compilation from published literature and from unpublished data in the files of the Bureau of Aeronautics and the National Bureau of Standards, representing the most pertinent information available on the fatigue of metals.

A large proportion of fatigue failures can be attributed to the lack of knowledge or appreciation of engineering principles on the part of designers, machine shop superintendents and workmen, inspectors and others having to do with the design, construction and servicing of aircraft. When the principles brought out in this compilation have been studied and applied by the personnel of the Navy and the firms supplying aircraft and parts to the Navy, the Bureau of Aeronautics anticipates an appreciable effect on the prevention of failure of aircraft parts under repeated stress.

The wide treatment given the subject in this volume justifies reproduction here of a partial list of contents: Failures under repeated stress; local nature of the fatigue nucleus; endurance strength—the S-N curve; rotating-beam endurance test; stress distribution; fillet radii; protection against corrosion fatigue; surface layers and coatings; severity of notches in hard steels; cold working; overstressing; the damage line; peak stresses; crack propagation; varieties of fatigue testing methods; effect of temperature on fatigue; yield strength limitation in fatigue; mitigation of stress concentration; surface coatings and surface conditions; inclusions and directional properties; damage produced by repeated overstress above the endurance limit; welded and riveted joints; terms used in discussing mechanical properties of metals.

Prevention of the Failure of Metals Under Repeated Stress, by the Staff of Battelle Memorial Institute; John Wiley & Sons, Inc., New York, 1941; 273 pages, $2.75.

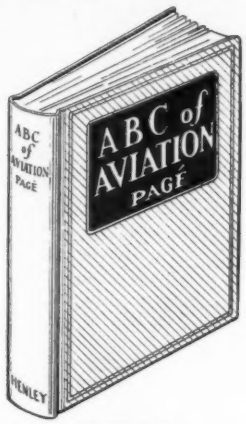
Airports

The 1941 edition of this standard reference handbook lists by states the airports, landing fields and seaplane bases in the United States. It describes landing facilities, size, condition, etc., and is an aid to the cross-country pilot.

As drawings are sometimes confusing and hard to decipher, aerial photographs of airports are used. In addition, information regarding airports of entry, control airports, radio stations and weather station telephone numbers is given.

Airports—1941; The Airport Directory Company, Hackensack, N. J.; 240 pages, $2.00.

NEW AVIATION BOOKS



1941 EDITION
ABC OF AVIATION
A GUIDE TO MODERN AIRCRAFT
By LT. COL. VICTOR W. PAGE
598 Pages 284 Illustrations Price $2.50
A SIMPLIFIED EXPLANATION OF ALL TYPES OF AIRCRAFT WITH CONDENSED INSTRUCTIONS ON THEIR BASIC PRINCIPLES OF CONSTRUCTION AND OPERATION, DESCRIBING IMPORTANT RECENT DEVELOPMENTS IN AIRPLANES AND ENGINES, INSPECTION AND TROUBLE SHOOTING, INSTRUMENTS USED FOR BLIND FLIGHT, PLASTIC AIRPLANES, AIR AND LIQUID COOLED ENGINES, CARE AND INSPECTION OF LIGHT AIRPLANES, ETC.

LUBRICATION AND MAINTENANCE CHART
Size 25 x 38 inches Price 50 cents
Enlarged wall chart showing sectional views of late model twin-bank aircraft radial engine, printed in three colors with a special reference to lubrication and fuel systems, starting and operation, running and ground tests and regular inspection procedure. A valuable reference for all maintenance men.

METAL AIRPLANE STRUCTURES
by Major FLAVIUS EARL LOUDY
455 Pages Price $5.00
293 Illustrations and Charts—68 Tables
A practical treatise on the design and construction of various types of airplanes, their structure and underlying principles of design, structural elements, welded and riveted joints, stressed skin design, metal wings and beams, fuselage, hull and float design.

1941 EDITION IN PREPARATION

AIRPLANE SERVICING MANUAL
By LT. COL. VICTOR W. PAGE
1050 Pages 500 Illustrations Price $6.00

AERIAL NAVIGATION AND METEOROLOGY
by CAPT. LEWIS A. YANCEY
350 Pages 102 Illustrations Price $4.00
AN INDISPENSABLE BOOK FOR THOSE PREPARING FOR TRANSPORT PILOT EXAMINATIONS AND FOR SCHOOL AND HOME STUDY.

AVIATION ENGINE EXAMINER
By LT. COL. VICTOR W. PAGE
440 (6x9) Pages 244 Illustrations Price $3.00
A systematic course of lessons for home or school use in question and answer form for those wishing to qualify as aircraft engine mechanics.

ABC OF GLIDING AND SAILFLYING
by V. W. PAGE
294 Pages 72 Illustrations Price $1.50

THE NORMAN W. HENLEY PUBLISHING COMPANY
17-19 WEST 45th STREET, NEW YORK, N. Y.

Primary Weather Text

Designed as a textbook for a one-semester course in elementary meteorology, this presentation outlines the underlying physical laws that produce weather and climate on the assumption that the reader has little or no knowledge of physics. Therefore the course is launched with a study of the composition and nature of the atmosphere, its movements and its physical properties under varying conditions.

The instruments used to measure and record these changes are explained, and their function correlated with the general problem of weather study. Clouds and their formations, characteristics and classification, fog and its causes and precipitation in its various forms are carefully examined, as is the nature and effect of radiation on temperature changes.

The formation and movement of cyclones and anticyclones and their migration and formation are considered, as well as fronts, source regions and air masses. Violent meteorological phenomena, thundershowers and tornadoes are dissected and explained, giving a particularly clear picture of the electrical phases of thunderstorms.

The last two chapters are devoted to the function of the Weather Bureau and the methods used in weather forecasting. A simple explanation of air mass is also offered. The book concludes with an introduction to climatology.

Meteorology, by Donald S. Piston; 2nd edition, The Blakiston Company, Philadelphia, 1941; 233 pages, $3.00.

How Airlines Are Run

A number of volumes have been published recently on the mechanical side of running an air transport system. Its counterpart—the principles of management, operation and sales, fundamental to any form of transportation—is the subject of this work. The principles applied to transportation systems in general are being adapted, the author shows, to their proper place in air transport.

The history of modern airlines is outlined briefly, starting with the pioneer air mail flights by Earl Ovington under the direction of the War Department. Air transport's progress is traced through the early operation by the Post Office and by private contractors to the modern multi-engined transport with its large pay load of passengers, express and mail.

The modern airline is "dissected," department by department, to show how each functions and is part of the closely-knit unit. Management's function is made clear by sample minutes of periodic conferences in which the president and other officials confer with heads of departments. The conference plan of management, it is pointed out, usually results in closer cooperation between departments and in more intelligent long-range planning.

One of the illustrations frequently referred to is a typical organization chart. The bulk of the actual work of running the airline comes under the vice-president in charge of operations. While there are departments under him, they do not function as individual units, and the job of correlating them is one of the major aspects of airline operations.

The links between the several components are described—the relationship of maintenance with communications, field operations and engineering; the engineering department with radio and with meteorology, and flight operation's dependence on all of them. Each individual department is outlined as to its personnel, equipment, function and its responsibility to the airline as a whole. Flight crews, service, and maintenance and communication, both on the ground and in the air, as well as station organization, are similarly treated.

Comprehensive discussion is given the subject of flight control. Among those phases described are: the system by which airline operation continues in adverse weather conditions, clearance procedure, control of traffic on the airways, low ceiling approaches, let-down procedure, and the safeguards and controls exercised both by Federal authorities and by the airlines themselves. The special application of meteorological data to airline operation and the weather reporting and forecasting system created particularly for transport safety are outlined. This chapter includes a simplified explanation of the air mass analysis system.

Scheduling is the link between operations and passenger service. This is the complex task of flying airplanes to suit the demands of operational safety, cargo, mail and passenger traffic. The factors such as seasonal traffic, weather, equipment and their effect on scheduling are explained.

The working of other departments not directly connected with operations is outlined as part of a system almost as complex as operations. Among these is passenger service, which is responsible for handling passengers, securing reservations, seeing that passengers arrive on time, and informing stations ahead of the amount of space still available. The physical comfort of passengers, food, ground transportation, luggage handling and similar details are the task of passenger service.

The task of selecting and training employees and seeing to their welfare, of studying flying equipment and methods and in keeping the line technically up to par are indicated to be among the most important links in the chain of efficient operation.

The purely executive direction of air transport is given several chapters. The system by which airline purchases are made, the stock control system, the sales unit and its organization, advertising and publicity, and finally the treasury department whose duty it is to adapt conservative practices to the peculiarities of the air transport business are discussed in detail.

Written from inside a major airline by the airport engineer for Eastern Air Lines, Inc., this book reiterates one idea in particular: an airline *must* be a completely integrated unit. The interdependence of the various phases of operation is brought out repeatedly, and the unique system by which one department can consult another directly is indicated in many instances.

Outline of Air Transport Practice, by Albert E. Blomquist; Pitman Publishing Corporation, New York, 1941; 402 pages, $4.50.

Fluid Mechanics for Students

After four years' experience in teaching fluid mechanics to many junior engineering students, Glen N. Cox and F. J. Germano, of Louisiana State University, have designed a test to "prepare the student for the problems to be encountered in the industrial field."

Abstract hydrodynamical reasoning is touched on only briefly, the bulk of the text dealing with the practical study of the behavior of fluids. Concepts developed in the hydraulics field have been largely retained, but with much less emphasis being placed upon the purely empirical equations. The material has been expanded to include what might be termed the industrial fluids. To accomplish this goal, both liquids and gases are covered.

The text is roughly divided into five parts; hydrostatics, measurement of fluids, transportation of fluids in closed and open channels, dynamics of fluids and centrifugal pumps. Short chapters concerning viscosity and dimensional analysis are introduced prior to consideration of the different measuring devices. In this way, dimensional reasoning and the effect of viscosity are considered throughout the remainder of the text wherever desirable.

As is usual in a text of this type, problems are appended at the end of each chapter.

Fluid Mechanics, by Glen N. Cox and F. J. Germano; D. Van Nostrand Company, Inc., New York, 1941; 274 pages, $3.00.

NEW AERONAUTICAL BOOKS

COMMERCIAL and PRIVATE PILOTS: New "Aeronautical Training" fully covers new multiple choice examinations, with drift, off-course and alternate airport problems plotted and solution given. Load factor problems also solved. Commercial examinations are shown in separate section of the book. Navigation, Meteorology, Aircraft, Engines and CAR covered. Just published—12th edition only $2.00 postpaid, or C. O. D.

INSTRUMENT FLYING by Lt. Comdr. P. V. H. Weems, U.S.N. ret., and Charles A. Zweng, Instructor, U. S. AIR CORPS. A new and different book known as the "Howard Stark edition" written especially to prepare the pilot for the government examination for "instrument rating." Radio-Telephone Permit included, with Meteorology, Radio-Orientation, let-down, offcourse and alternate airport problems. DeLuxe edition, red leatherette cover with gold letters. Only $4.00 postpaid.

FLIGHT INSTRUCTOR: A new quiz text covering the scope of the written examination for flight instructor rating. Illustrated with pertinent diagrams. $2.00 postpaid or C. O. D.

GROUND INSTRUCTOR: A new book, prepares for government examinations on Navigation, Meteorology, Aircraft, Engines and CAR. Why fail? Only $3.00 postpaid.

A & E MECHANICS RATING: Airplane and Engine Mechanics—Can you pass your written test? Send for new quiz book covering Airplanes, Engines, and Mechanics' Civil Air Regulations. 156 pages, fully illustrated, with complete sets of latest examination questions. Only $3.00 postpaid or C. O. D.

RADIO AND INSTRUMENT FLYING by Charles A. Zweng. Instructor, U. S. AIR CORPS. New 1941 Edition covering new important material. Written especially to prepare the pilot for government examination for "instrument rating." Radio-Telephone Permit included with Meteorology, Radio-Orientation, let-down, offcourse and alternate airport problems. Only $4.00 postpaid.

NAVIGATION PLOTTER (Dept. of Commerce type) is necessary for all problems involving drift, let-down and offcourse, including alternate airport problems. May be used when taking examination. Complete with large leatherette Navigation Note Book and instructions, only $4.00 postpaid.

AIR NAVIGATION (Gold Medal Edition) includes meteorology. $5.00 postpaid.

SIMPLIFIED CELESTIAL NAVIGATION by P. V. H. Weems and E. A. Link, Jr. $3.00 postpaid.

DALTON MARK VII AIRCRAFT COMPUTER. With book of instruction . . . $7.50.

Order From

Pan American Navigation Service

1435 Flower St., Dept. FA, Glendale, California

JORDANOFF'S

SAFETY IN FLIGHT

has just been published!

HERE is the magnificent companion volume to YOUR WINGS and THROUGH THE OVERCAST, that describes airline methods of flight planning and control for any pilot to use for his safety and the safety of his passengers.

OVER 400 ILLUSTRATIONS

The ultimate knowledge you need for complete safety in the air is fully explained and illustrated—from how to get and use information about upper-air conditions, through the very latest instrument flying techniques, including Braznell Instrument Method, the installation and use of Learmatic Navigator, etc., etc.

● Size 7" x 9½". Durable cloth binding. $3.00. At book stores or **FUNK & WAGNALLS COMPANY, 354 Fourth Ave., N. Y.** Write for FREE circular.

War Edition of Jane's

Compiling and editing the specifications and performance data on *All the World's Aircraft* while most of the world is at war cannot but be a difficult task. Great Britain, Germany, Italy and Russia as principal belligerents, and the United States as a supplier of combat aircraft for Great Britain, take every precaution against the release of information on the newer types of military aircraft. Even the details of captured enemy airplanes, other than those of the most general nature, are closely guarded military secrets.

In addition to the restrictions on military aircraft, information from German-occupied countries—Norway, Denmark, Holland, Belgium, Greece, Yugoslavia, Rumania, Poland and France—is no longer available. In spite of these handicaps and the shortage of paper in England, the 1941 edition of Jane's lacks neither size nor substance. Lack of material from occupied countries has more than been compensated for by descriptions of many new types of commercial and private airplanes in the United States.

The volume is edited in five parts. The first reviews developments in military aviation, and features a thirty-page description and chronology of British air effort in the War. The second section lists pertinent data on civil aviation, government departments, associations, air lines, publications and flying schools. The main section, Part C, contains photographs of hundreds of different types of airplanes in current use. It is said that 257 new photographs have been added to this section in the past year. A fourth part covers the latest types of aircraft engines. A single-page summary of lighter-than-air developments in Germany and the United States up to the outbreak of war completes the new edition.

Jane's All the World's Aircraft, 1940, edited by C. G. Grey and Leonard Bridgman; Sampson Low, London, 1941; 532 pages, $22.50.

Preparation for Flight

This presentation of the theory and practice of flight approaches the problem from an uncommon angle. The author presumes that the student digests most of the primary flight theory before he ever gets into the cockpit. Therefore, this pre-flight primer presents the basic material on the whys and hows of flight stripped of technical terms and outlined in non-aeronautical parallels.

Flight theory is explained in terms of kites and birds, while answers are given to such usual primary questions as why is an airplane, monoplane or biplane; what forces act on the craft in flight and how can we recognize them. Everyday phenomena are used for illustrating these explanations. In broaching the actual process of flying, the author presents the physical and psychological factors involved and the importance of acute vision. Considerable space is given to explanation of the attitude and philosophy which the student must adopt if he is to be a successful pilot.

In outlining primary and aerobatic flight, no attempt is made to give complete instructions on how the maneuvers are to be done. Rather, the future student is prepared for what to expect. While it is no substitute for an instructor or his advice, the book affords sufficient information on the nature and actions of the airplane, and the student's place and responsibility, to permit him to enter the cockpit without the utterly lost feeling of a total stranger.

The Student Pilot's Training Primer, by Col. Hugh J. Knerr; D. Van Nostrand Company, Inc., New York, 1941; 172 pages, $2.00.

Manual for Air Youth Leaders

A nation-wide survey of youth activities in aviation made by Air Youth of America in 1938 and 1939 revealed that aviation was the leading vocational interest of boys in public schools and that nearly two million boys and girls build and fly their own models. It was also found that many teachers and youth leaders hesitated to organize model club groups because they felt that they lacked sufficient technical background.

This book has been designed to meet the needs of the group leaders. It contains complete directions for the organizing of junior aviation groups and clubs, and tells how to plan a program of activities and how to utilize Air Youth Projects in youth programs. Although many phases of aviation are discussed, including a complete section on gliding and soaring, emphasis is placed on the building and flying of model airplanes as a practical introduction to the study of aviation.

Air Youth of America has published several books dealing with youth activities in aviation, and its program for the directing of the enthusiasm and energy of American youth speaks well for the future of juvenile aviation in this country.

Youth in Aviation; published for Air Youth of America by D. Appleton-Century Company, New York, 1941; 265 pages, $2.50.

Basic Propeller Manual

A basic guide to propeller theory and maintenance, this text is presented in the form of the logical questions students might ask and the simplest answers available. Propeller theory and basic definitions such as true-pitch propeller, geometrical and effective pitch and the forces acting on propellers are explained. In a chapter on basic fundamentals, the physical shape of propellers, materials used, simple repairs commonly made in the field, and the principles of maintenance are given compact but thorough treatment.

In discussing C.A.A. regulations, the particular part of the Air Commerce Manual referring to propeller repair and maintenance is explained, with particular emphasis on those damages which can be repaired and those which require replacement, with suggestions as to analysis from this point of view.

All of these principles and regulations are described as they apply to actual types of propellers in current service. Wooden and metal fixed pitch propellers, manually adjustable, two-position and constant-speed propellers, hydrodynamically, mechanically and electrically adjusted propellers are examined as to their uses, characteristics, construction and maintenance.

A typical examination of all the phases of propeller theory and maintenance, such as might be given by the C.A.A. is offered the student as a check of his study of the book. A glossary of all the technical terms used is at the end of the book. The use of the question and answer technique, while not applicable to all types of books, works out well in this case, enabling the practical side of propeller maintenance to be covered in comparatively few pages.

Aircraft Propellers, by Carl M. Harlacher; Aero Publishers, Inc., Glendale, Calif., 1941; 119 pages, $2.85.

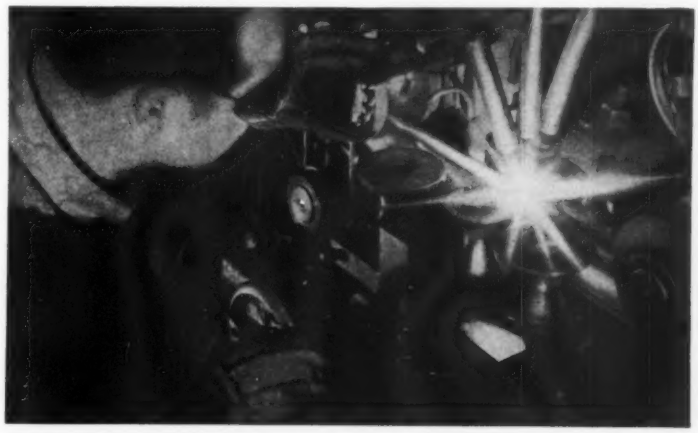
Tubing

Improvements and refinements in the processes for manufacturing welded carbon and alloy steel tubing have led to increased adoption of this material for structural uses. The *Handbook of Welded Steel Tubing* was published to furnish designing engineers with full information regarding standard sizes and properties of welded tubing.

Only those grades of welded tubing are considered which can be figured as having a solid wall structure with no discontinuity or variation in physical properties occurring in the area affected by the welding operation during manufacture. Standard sizes, together with commercial tolerances for roundness, wall thickness, straightness, etc., are tabulated for various grades of welded tubes. The manufacturing and fabricating processes are illustrated, and dimension-drawings show on typical examples to what degree welded tubing can be cold-worked in such operations as bending, beading, flanging, expanding, tapering, etc.

Special attention is given to recommendations for laying out fabricated parts and for methods of checking. Suggestions are also offered to aid in developing designs for the most economical use of tubular sections. Illustrations show a variety of possibilities for using tubular members for other purposes than now most common. The Handbook is of pocket size in a loose-leaf binding.

Handbook of Welded Steel Tubing; Formed Steel Tube Institute, Cleveland, Ohio, 1941; 86 pages, $1.00.



Welding stainless steel tubing with an atomic hydrogen arc. From the *Handbook of Welded Steel Tubing.*

Model Builder's Bible

In numberless cellars, attics, clubrooms and workshops throughout the United States, about two million young Americans and a vanguard of adults engage nightly in the construction, repair and design of airplane models. Some of these are gliders, others are powered by rubber bands, while an increasing number have miniature gasoline engines. This volume is the first in a series to be published annually to present an account of the year's progress in all the phases of this popular hobby.

To bring the reader up to date on the subject of airplane modeling, the book opens with an account of the National Model Airplane Meet which was held in Atlantic City in 1933. Here, two Philadelphians, William Brown and Maxwell Bassett, upset all previous rules for running meets and building models by entering a model powered by a small internal-combustion engine. The result of the gas-powered model's competition with the previous rubber-powered types resulted in revolutionary changes in model building and competition procedure. It also brought with it a minor industry and a new type of power-plant engineering.

Up to 1939, various temporary rules governed competition. In that year, a system for classifying engines by size and for limiting flight time was adopted by the Academy of Model Aeronautics, a section of the National Aeronautic Association, under whose sponsorship official meets are held. Model building, however, is older than most people think. Flying models, powered by steam, rubber, whalebone, etc., were flown by experimenters as early as the middle of the last century.

From the history of model building, the book turns to current progress, outlining technical changes which took place, such as the trend toward smaller gasoline models with tougher structures, the introduction of the pylon and single wheel design.

A large number of pictures and captions, which occupy the greater part of the book, indicate the trends in model engineering. A considerable amount of space and illustrative material are devoted to developments in materials, techniques and the building applications of new products. Following closely the style of full-scale engine manuals, the popular model power plants currently on the market are presented and their characteristics and specifications listed. The book is concluded with a comprehensive presentation of the rules governing model air meets as promulgated by the N.A.A.'s Academy of Model Aeronautics.

The Model Plane Annual 1941-1942, by Frederick P. Graham and Reginald M. Cleveland; Robert M. McBride & Company, New York, 1941; 254 pages, $2.00.

British Aeronautical Glossary

The increased interdependence between the United States and England on aeronautical matters has made it increasingly important that Americans be familiar with British technical terminology. For that reason, this glossary of aeronautical usages and expressions based on the nomenclature adopted by the British Standards Institute in conformity with Air Ministry recommendations, is worthy of study.

Certain terms which are frequently misapplied are pointed out, such as *velocity* used as a synonym for *speed*. Certain simplifications are suggested, such as the use of *fuel* instead of the word *petrol*, which is often confusing.

Several hundred terms from *Abney level* and *absolute ceiling* to *yawing* and *zooming* are defined. In many cases the explanations are clarified by the use of illustrations, which fill every alternate page. This glossary indicats considerable simplification and a tendency to drop many inexact and duplicate terms. The author omits the word *airplane* the equivalent in the United States to the English *aeroplane*. Although the word may be distasteful to English aeronautical writers it definitely has a place in any such nomenclature if only to refer to its origin. Also included in the volume are silhouettes of currently used German and Italian military airplanes.

Glossary of Aeronautical Terms, by Douglas H. Nelson; Chemical Publishing Company, Inc., Brooklyn, N. Y., 1941; 112 pages, $1.50.

New International Yearbook

Some seven pounds lighter than the last edition of *Aerosphere*, the 1941 edition continues where the 1939 edition left off. This time, the complete, comprehensive engine history which made the first *Aerosphere* monumental in size and scope is limited to reviews of current aircraft and power plants.

The first section of the revised general aviation reference text is devoted to modern aircraft. It opens with a list of the types supplied to the Royal Air Force by American airplane builders. The names of the manufacturers, the U.S. identification or serial number, the British name, the power plants, the age of the design and whether the airplane is in production, on order or being delivered, are indicated.

Serial numbers on American military aircraft are confusing to many people, even inside the industry. An explanation is given of how these initials are built up and altered, both in the Army Air Corps and in the Navy Department Bureau of Aeronautics. Serial numbers for both Army and Navy airplanes in current use are listed and identified with the specific aircraft.

The airplane description section of the book furnishes the name, type specifications, construction, instruments, performance and power of aircraft built in the United States, England, Germany, Japan and 22 other countries. In the case of occupied countries this information was brought up to date only to the point where the nation capitulated to Germany.

The engine section is similarly treated; it describes engines built in the United States and fourteen other countries. This section includes pictures and descriptions not only of production models but also of auxiliary power plants and experimental types not yet in production.

A large portion of the book is devoted to general aircraft and aeronautical statistical information covering a wide field. Photographic comparisons are made between World War, post-war and modern military aircraft in the attack, pursuit, bombardment and observation types in Army service.

In a special chapter on the history of Naval Aircraft, observation, scouting, torpedo and bombing types, as well as long-range patrol boats, are traced from their first use in the U.S. to date. A brief history of Coast Guard aviation is also included.

The compendium of generally used aviation information which follows includes such material as world's records in various categories and the names of their holders. U.S. records are given separately. Officers and members of important aeronautical organizations and political agencies, the names and standing of congressional committees interested in aviation, C.A.A. officials and inspectors, and members of the Bureau of Standards working in aviation are among the lists presented. Other useful lists include schools participating in the Civilian Pilot Training Program, the status of airports, listed by states, the status of aircraft and gliders, figures on air mail and express and on air line traffic.

The last part of the book is devoted to an alphabetical listing of firms and organizations engaged in aircraft activities, including businesses that build products used directly or indirectly in the building, maintenance and operation of aircraft. The names, officers and products of American companies and similar firms in 34 other countries are furnished. The list is arranged both by company names and by products. Geographical listing is given only for American firms.

Aerosphere—1941, edited by Glenn D. Angle; Aircraft Publications, New York, 1941; 948 pages, $10.00.

American Aeronauts of Note

In an earlier book, the author wrote of famous flights. In this current work, he gives biographical sketches of the Wright Brothers, Curtiss, Rickenbacker, Read, John Rodgers, Byrd, Lindbergh, Amelia Earhart, Hawks, Post, Musick, Hughes and Corrigan.

For those who wish to secure an impression of any of these pilots, the book will be interesting and useful. For those who wish careful accuracy, it will have to be regarded as a secondary source of facts, as many statements are made which are not in accord with first hand research. The chapter on the Wright Brothers should be accepted as a restatement of much that has been written which is inaccurate but may be good reading.

Biography and history are not exact sciences, but are intended to give general interpretations of events and persons. This book does exactly that. Definitive biographies are the result of more intense study, and often, because of it, are dull reading. These sketches are easy reading and will be informative to youth who seek aviation careers.

Famous American Flyers, by Chelsea Fraser; Thomas Y. Crowell Company, New York, 1941; 352 pages, $2.50.

Historic Handbook Revised

The degree to which aviation has grown since the last world war is indicated in sharp relief by the third revised edition of Lieut. Col. Pagé's simplified guide to aviation. The book first appeared in 1918, printed between paper covers for use in service schools. Cloth covers and popular circulation followed, and it remained for a number of years one of the few works in general circulation on aircraft construction, care and operation.

The 1941 edition carries a full exposition of current aircraft types with instructions on the basic principles of their structure and operation. Descriptions of gasoline and Diesel power plants and recent trends in construction are presented with material on trouble-shooting, instrument maintenance, primary flight and aerobatics instruction, instrument flying, radio and avigation.

While the material explained and illustrated has been thoroughly revised and brought up-to-date, enough of the original illustrations are retained to give the book background and the reader a feeling that aviation has a history and a past as well as a much-advertised future.

ABC of Aviation, 2nd revision, by Lieut. Col. Victor W. Pagé; The Norman Henley Publishing Co., New York, 1941; 598 pages, $2.50.

Sheet Metal Text

Designed as a student's shop text and mechanic's reference book, this primer on the essentials of aircraft sheet metal work begins by defining what a sheet metal mechanic is, lists the minimum educational background he must have, defines his place in the industry and describes the hand tools which constitute his personal kit.

In describing active sheet metal work, the author begins at the beginning with blueprints, working drawings and layouts. Rather than launch any book-length discussion on the subject, the basic essentials of reading prints and three-view drawings are covered, and more complete references on blueprint reading are recommended to the reader.

Layout, the process of transferring the drawing directly to the metal, receives more thorough treatment. The tools and materials used for layout are described and general rules for their use are given, along with simple problems in actual layout. In surprisingly little space, using simple arithmetic, basic algebra and the most rudimentary form of solid geometry, methods are shown for making common computations for use by the sheet metal worker.

From this point on, the book concerns itself with the actual factory and field operation of the metal mechanic. Following a definition of the problem, the tools are described together with their use in all the essential steps in metal aircraft construction: cutting, drilling, bending, rolling, stretching and shrinking, forming and bumping. The final chapter deals with repairs on sheet metal structures.

Aircraft Sheet Metal Work, Vol. I—Bench Repair Work, by H. Edward Boggess; Pitman Publishing Corporation, New York, 1941; $1.00.

The Earth's Atmosphere

Meteorology from the physicist's point of view treats particularly of meteorological phenomena. It usually excludes for want of scientific dependability the many empirical and subjective problems which occupy the meteorologist. This phase of air study therefor forms the logical complement to meteorology in the field of aeronautics.

Prof. Humphreys' book has long been the outstanding textbook on air physics. A revision appearing at this time should fill the considerable gap of scientific developments in this field since the second edition of the work was made available in 1928. However, in this third edition, as previously, the author's treatment of practical meteorological problems is somewhat scant and suggests little of the extreme difficulties involved in this field and the great progress made in the last ten years.

Advection fog, seen from Mount Wilson, California. From *Physics of the Air,* by W. J. Humphreys.

The greatest rapprochement between physics and meteorology during recent years—the subject of turbulence and the applications of fluid mechanics to meteorology—likewise justifies a more intensive examination than is afforded in the new edition. Broader treatment of these subjects will be missed chiefly by students having no access to other special works.

The chapter and section content and the format of the new edition are unchanged. Errors in the previous edition have been corrected and certain new material has been added, though little of the old text was omitted or extensively rewritten. The work remains the classic standard in its field.

Physics of the Air, by William J. Humphreys; 3rd Edition, McGraw-Hill Book Company, Inc., New York, 1940; 676 pages, $6.00.

Dynamics Study of Engine Design

Design of high speed engines is usually divided into its various branches of thermodynamics, dynamic study, design of parts, actual layout and dynamometer test. With the exception of special treatments of torsional vibrations and balancing, it is stated that little has been done on the dynamics study of high speed engines.

This volume, according to the author, is an endeavor to present a text on the dynamics study of engine design for both the advanced student and design engineer. He believes that a concise presentation of the subject should be particularly useful in the early stages of design, prior to actual layout. In this work, analysis has been restricted to calculus and simple harmonic theory with no attempt to make use of the higher branches of mathematics.

The first chapter outlines in brief the different thermodynamic cycles and is included in the text as a review, with a graphical method outlined for the purpose of constructing the indicator diagram. Four chapters are given to a discussion of engine balance of different types: in-line, V-type, radial and off-set cylinder engines. Examples are offered to demonstrate characteristics of the different types.

The more general methods of obtaining the frequencies of torsional vibrations of crankshafts are described with a graphical method for practical use. An account of the development of the equations for lift, velocity and acceleration of the more common cams used on high speed engines is followed by a suggested method of harmonic analysis which can be applied to any form of valve lift curve.

A section on firing orders is not primarily concerned with dynamics of the engine, but is a study with which the engine designer must familarize himself. For this reason, examples of the more common types of in-line and V-type engines are offered to illustrate the mechanics of this particular study. A graphical method of presentation shows the manner in which the firing occurs along the cylinders. The book is inexpensively reproduced in photo-offset.

Analytical Design of High Speed Internal Combustion Engines, by Fred M. Cousins; Pitman Publishing Corporation, New York, 1941; 230 pages, $3.50.

Power Press Text

A study of the practical application of the principles used in the design of punches and dies in modern press work. Although the volume is designed for general press work and makes few direct references to aircraft applications, it covers the subject thoroughly and should be valuable to those wishing to design for pressworking.

The selection and use of various types of presses is demonstrated, and explanations are offered for the selection and handling of materials. The physical properties of strip and sheet metals are also described.

A considerable amount of space is given to press accessories and automatic feeding devices used to accelerate production. Much of the latter part of the volume is devoted to the principles of die problems upon which tool designs are based and to the mathematics necessary for press-tool design.

Pressworking of Metals, by C. W. Hinman; McGraw-Hill Book Company, Inc., New York, 1941; 443 pages, $4.00.

Handbook for Navigators

In the preface to this revision of his primary and very practical training text, Commander Logan C. Ramsey asks what would happen to air transportation in the U.S. if all radio range systems were blacked out in the event of war. He proceeds to suggest that under present conditions thorough training and practice in methods of dead reckoning and celestial navigation should be acquired by those who have hitherto found it unnecessary to do more than pilot by landmarks or fly the radio beam.

In treatment, the work is rather more a guide to "learning-by-doing" than learning by reading. Explanation is kept to a minim of simple and concise instructions for working various problems, and the descriptions of navigation equipment and working data are brief. Problems are of an extremely practical nature, many of them having been taken from flight logs of the U.S. Navy and the airlines. Typical of the latter is the flight log of a Pan American Airways Clipper from Oakland to Honolulu.

The fourteen chapters of the book are broken into seven parts. The first presents the value of navigation and an introduction to its terminology. The second part contains information on maps, instruments, accessories and the compass. Part three deals with dead reckoning, and the following two sections, respectively, concern piloting and aerial astronomy.

In Part six, the author discusses actual procedure for planning and navigating aircraft flights (a) of less than 200 miles (b) of 200–800 miles and (c) of long distance flights. Necessary equipment and preliminary work are outlined; the steps of each flight are illustrated in terms of an actual flight log. The latter were selected for their varied weather conditions which called for careful and accurate navigation.

The final section, on aerology and navigation, outlines the importance of applying meteorology to flight planning and air navigation. Included are two tables: one on wind direction changes with altitude, the other on wind velocity changes with altitude on a basis of averages compiled by the Weather Bureau.

A separately bound supplement, titled *Air Pilots' Dead Reckoning Tables,* furnishes eight tables which are said to provide the same speed and more accuracy than a computer. These are self explanatory and are recommended for pilots who hesitate to rely on their skill with computers for drift angle and radius of action problems.

Navigation of Aircraft, by Logan C. Ramsey; The Ronald Press Company, New York, 1941; 230 pages and 48-page separately bound supplement, $4.50.

Hemisphere Defense

The pen of the *New York Times'* military and naval correspondent has often dipped into aeronautical matters, but never with more seriousness nor more earnestness than in his latest work. It examines the political and economic —but particularly the strategic and military—aspects of hemisphere defense. Its purpose is to "prod the minds of even a few Americans to detailed examination of the greatest problem of our day."

As keynote of his effort to pose our alternatives in so far as they can be seen, he writes that "America must within the next twelve months take the road of war or the highway of precarious peace." The problem of defense, primarily the military elements of defense, is dealt with, but not in the static concepts of past wars. Defense is viewed, rather, against the background of war, hence an important part of the book deals with the lessons of this war—starts with Gamelin, "forgotten man of history," and ends with Roosevelt, "key figure in America's hour of decision."

As the book was written before Crete was captured by air forces alone, the author states that one of the "grand illusions" shattered by the present war is that regarding the rôle of air power as a self-sufficient unit. He was of the opinion then that the military successes of the Germans had not been achieved by the use of any one weapon or any one arm; they were wrought by unified, coordinated operations by air, land and sea.

Among observations regarding territorial security on this continent, the author, agreeing with those who believe that the U.S. could not be invaded by air, writes, "Air power has not yet shown its ability to hold territory or to consolidate conquests. It is a terrible engine of destruction, but alone it could not be the instrument of victory against America." He refutes any suggestion that an army can reach these shores by air. In so qualifying the means of such invasion, it is possible the author anticipated the German invasion of Russia and its threat to the Siberian land route to the Bering Straits. Danger from Axis commercial air operations in Latin-America is minimized.

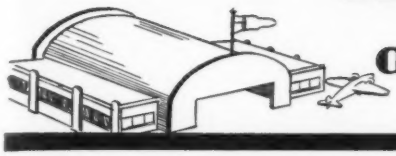
In a chapter titled, "Our Air Forces—Arm of the Future," American air power is said to be far ahead in technical advancement and the quality of its men and machines; but, in numbers, in production rate and in battle experience, it is "far behind the procession." The potentialities of American air power, it is said, will be realized, though not without waste, extravagance and trial and error. Air power's greatest need is held to be a definition of purpose—a "central doctrine to link it to the central purposes of man and to coordinate it with the other instruments of force." The second need of air power is said to be bombers—long-range bombers that "can leap from the seas" to carry the war to the enemy.

Among predictions sounded by the author, one of the most far-reaching is that "air power is now, and is destined to be even more so, an aggressive arm, perhaps the chief implement of that aggressive defense that alone can render inviolate America's security. Certainly it can be a powerful instrument for good. Like our fleet that is still upon the stocks, the blueprint planes of tomorrow, the future patrol force of the world, will help to make the peace and keep it."

The quantity of generalization and the variety of opinions set down by the author are well coordinated and reasonably consistent in viewpoint, however vague or debatable the reader may find them. A section of notes to the text clarifies many of the writer's remarks, and an appendix provides much pertinent statistical and other information on war reserves in the Western Hemisphere.

United We Stand! Defense of the Western Hemisphere, by Hanson W. Baldwin; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1941; 364 pages, $3.00.

House Organs and Catalogues



Cleaning before Spot Welding

Proper Metal Surface Preparation for Spot Welding. The pre-cleaning and etching of surfaces to be welded are important factors in successful spot welding of aluminum alloys. This preparation is necessary in order to provide the electrode with perfect contact. The two steps involved are the removal first of all stamping and flushing oils, identification marks, grease, etc., then the removal of the metallic oxides which are invariably present.

When not properly prepared, the oxides on the surface of the alloy cause a high resistance between the parts to be welded, which results in particles of aluminum and fused aluminum oxide being picked up by the electrodes. When this happens, welding must be stopped and the electrodes resanded or remachined to remove the objectionable matter.

By the use of the Oakite methods for preparing the alloy for welding, it is claimed that the number of welds between electrode cleanings can be substantially increased. *Oakite News Service*, May-June.

Instrument Primer

Facts about Kollsman Aircraft Instruments. A 48-page booklet prepared by the Kollsman Instrument Division of the Square D Company to answer frequent questions on the use and function of aircraft instruments. In outlining the uses of flight instruments, the text defines contact and instrument flight and lists the instruments necessary for the safe execution of each type of flying.

Common flight and engine instruments are described with an explanation of their function and use. Standard and sensitive altimeters, air speed indicators, pitot static tubes, compasses, clocks, direction and ice warning indicators and the vertical speed or rate-of-climb indicator are the flight instruments reviewed.

A section on engine instruments similarly treats of the engine gage unit which combines the oil thermometer and pressure gage and fuel pressure gage; the engine thermometers for measuring temperatures of coolants in liquid-cooled power plants; the heat of the lubricating oil and the fuel-air mixture in the carburetor. Other engine instruments, the fuel quantity gage, manifold pressure, pressure and suction gages and the warning unit frequently used with it are reviewed along with the various types of tachometers and synchroscopes.

The final section examines some of the less frequently used instruments, such as the accelerometer, remote control indicator or telegon systems, as applied to wheel and flap positions, ice indicators, direction indicators and other instruments. *Kollsman Instrument Division, Square D Company.*

Cyclone in the Making

The entire May issue of *Trade Winds*, house organ of the Wright Aeronautical Corporation, is devoted to the manufacturing story of a 14-cylinder Cyclone engine. The text, profuse with pictures, traces the engine from the raw stock to the shipping platform. The description of fabrication progress is broken down into the components of the engine, the making and finishing of each being explained. Special attention is given to the use of magnesium castings which have contributed to reduction of weight in the Cyclone design.

Following the account of the fabrication of components, the assembly of the 8,500 parts into a single power plant on the assembly line is given. From the assembly line, the completed engines go to the test stand and, after running in and inspection, are prepared for shipment and service. *Trade Winds*, May.

Paint Guide

Aluminum Paint Manual. A 96-page booklet issued as a guide for the selection of the proper aluminum paint for any particular service. Directions are offered for the most efficient methods of mixing and applying the paint selected and for the use of aluminum paint on various types of surfaces.

Aluminum paint, like other paints, consists essentially of a finely divided pigment dispersed in a suitable liquid, or "vehicle," and may be applied by the same methods and in much the same manner. But minor modifications of technique are required to secure adequate and satisfactory results. The manual affords a helpful understanding of this specialized technique. *Aluminum Company of America.*

Radio Equipment Manual

Radio Communication Systems. A 55-page loose-leaf manual describing the various types of radio communications systems built by Air Associates, Inc. It contains complete specifications and price information on radio systems for private, commercial and military aircraft.

The brochure is divided into six sections. The first gives information on long-range equipment and conventional and ultra-high frequency aircraft and ground receivers and transmitters. Section two contains material on school equipment and ground and airplane transmitters and receivers designed for instruction. Among the devices described is the Radio Range Instructor, used to simulate radio range signals as an aid to the instructor in demonstrating orientation problems.

Other sections contain information on interphone and antenna systems, receiver and transceiver equipment for light airplanes, and various accessory equipment such as selector switches, microphones, antenna and loading units, etc., all designed for use with Air Associates communications equipment.

Defense Figures

A Manual of Defense Data. A 16-page report on the state of defense preparation, production and planning for the first quarter of 1941, compiled by the Aeronautical Chamber of Commerce.

A comparison is made of the amount of money spent by the industry for plants and equipment as opposed to the earnings of the industry over the period between 1934–1940. The comparison indicates that in general the money spent on development and expansion amounted to 76 per cent more than the total profits for that period. This 76 per cent went into plant expansion, equipment and the training of personnel to man these plants. Figures and graphs on the increase of plants and payrolls are presented.

Graphic forecasts are made of airplane and engine production on the basis of 1939, 1940 and 1941 results as compared with the nation's productive capacity. New methods being used for production and delivery are outlined briefly.

A comparison is made between American-built military airplanes and

those produced abroad to show the excellence of American aircraft; credit for this is given to American superiority in aeronautic research. The further advantages that such improvements as increased power, laminar flow wings and jet propulsion will give future aircraft in speed, range and climb are indicated.

To show the contributions of the entire nation to the production of airplanes, a state-by-state list is presented showing the product, raw or finished material, furnished to airplane builders. *Aircraft Record*, May.

Making Wind-Tunnel Blades

Tremendous Force of Airstream in New Wind Tunnel. Because no existing propeller plant possessed facilities for making hollow steel blades of the necessary size for the 40,000 hp. electric fan system in the new Army wind tunnel at Wright Field, a crew of 36 carpenters and pattern-makers was set to work to build them of wood under the supervision of Major Edward M. Robbins.

Sixteen blades are mounted on each of two 40-ft. fans, which will rotate in tandem. Each wooden blade weighs 1,500 lbs., while the metal hub scales over 58,000 lbs. The 32 blades and eight spares are being built from 75,000 board feet of prime Washington spruce.

The 13½-ft. wooden blades are each divided by the pattern-makers into thirteen stations a foot apart. Templates were constructed for each of the 42 laminations, and two master templates for the face and camber side as well as metal finishing templates for each station. A special jig-press was built in which the laminations are glued together under a pressure of 2,000,000 lbs. Using special pneumatic spoke shaves and rotary handsaws, the blades are turned to shape and finished with hand planes and sandpaper. *Air Corps News Letter*, May 15.

Handling Aviation Fuel

Storage and Handling of Aviation Gasoline. George L. Stetson. A discussion of the problems involved in the safe handling and storage of aviation gasoline. Suggestions are made for preventing contamination of fuels in bulk storage both above and below ground, in refueling trucks and in drums.

In a series of six safety rules that are offered, the use of automotive fuels in aircraft engines is held undesirable because the vapor pressure of this gasoline is higher than in aviation gasoline. Vapor formation at high altitude may be sufficient to cause interruption of the fuel supply. Other precautions include checking tanks for accumulated moisture, and manifold tank valves for efficient separation, particularly on tank trucks carrying two grades of gasoline. *Shell Aviation*, April.

Flying Instructions Compared

When They Flew By the Seat of Their Pants. Col. Warren R. Carter, commander of the Advanced Flying School at Victoria, Texas, and Major John T. Sprague, director of flight training, have answered a series of questions regarding the differences in Army flight training methods used now and in the period between 1924–1931.

The passage of time has brought no fundamental changes in maneuvers and instruction work. The main differences are in the presentation of the instruction. Formerly, the student went through a series of training stages devoted to individual maneuvers. Instructors were assigned to these stages rather than to groups of cadets, and the number of "washouts" of failing cadets was relatively high. With the advent of the modern three-stage system—primary, basic and advanced—the cadet remained under the tutelage of one instructor and the "washout" rate showed a marked decrease. The types of equipment used during the earlier period, Curtiss JN-6H's and DH-4's, and the informal barrack life of that era are described. *Form One*, May.

For Junior Draftsmen

Pratt & Whitney Offers Special Course. To aid in meeting its urgent need for draftsmen, Pratt & Whitney is collaborating with the University of Connecticut in offering an intensive eight weeks' course of study designed specifically for the purpose. One of seven defense training projects of United Aircraft Corporation, the course presumes a lack of previous drafting experience but emphasizes the importance of a genuine desire to become an essential part of the aircraft industry.

Instruction includes complete courses in mechanical drawing, metallurgy, mathematics and shop theory. The training program has been laid out to provide the necessary theoretical background as well as the practical knowledge of materials, processes and graphical methods required of a draftsman. Frequent inspection trips supplement regular classroom activity. While in full attendance during a 40-hour week period, the student receives a pay of 50 cents an hour. Upon graduation and qualification as a junior draftsman, he is given employment in the Pratt & Whitney Aircraft Engineering Department at a minimum salary of $120 a month. *The Bee-Hive*, March-April.

Trainers to Peru

Ten 'Craft Trainers Start Peruvian CPTP. Ten 65 hp. Continental-engined Taylorcraft side-by-side trainers have been shipped to Peru where they will form the nucleus of a civilian pilot training program being inaugurated in that country. The trainers were acquired by the Liga Nacional de Aviacion, a patriotic group made up of prominent citizens.

While the Liga is still a private organization, financed by popular subscription, it is regarded as a phase of Peru's national defense. The idea of training qualified young men and women was launched at a Rotary luncheon a few months ago, and has the backing of the President of the Republic and other leading government officials. *The Taylorcraft News*, June.

Cross-Country Safety

Common Hazards in Cross-Country Flying. Charles B. Ripley. An engineer on the staff of Aero Insurance Underwriters notes the importance of gasoline supply, weather reports and navigation information as basic factors in safe cross-country flying. He cautions against trusting the gas gage or taking someone else's word as to the supply.

To be constantly informed where he is, a pilot should work out a navigation plan before take-off; check for drift in the first few miles; keep track of time over fixed points; record compass heading with corrections and know ground speed. If the pilot gets lost, the safest measure is to make a 180 degree turn and fly back to his last fixed point. *A.O.P.A. Section*, July.

White-Print Process

Descriptive material on the Ozalid positive printing process—a dry reproductive process designed for commercial and industrial usage. This method reduces from six steps to two the operations formerly required for making prints.

The Ozalid process involves exposure and development. It is a contact method of reproduction and depends on the transmission of light through the original, which must be translucent on one side of the paper. Exposure is made to sunlight or in a printer equipped with mercury vapor or carbon arcs. The actinic rays emitted by the light source convert the yellow salt of the Ozalid material into a colorless salt except where the print is protected by the opaque lines of the original. The development operation consists of exposing the print to dry ammonia vapor for a few seconds in the Ozalid dry-developing machine.

Its advantages and improvements over former methods for making blue prints and the types of machinery needed to use the Ozalid Process are described; included are sample-books of the paper, cloth and transparent foil used. *Ozalid Products Division, General Aniline & Film Corporation.*

Boeing Apprentices Graduate

Apprentice Program Expands. Fourteen young men, the first aviation apprentices to graduate under a plan supervised by the Department of Labor, received their diplomas on May 4 at the Boeing Aircraft Company plant in Seattle. These men completed four years of work, totaling over 8,000 working hours, before they were given journeymen's ratings and salaries.

The program, sponsored jointly by the labor union and the company through the Boeing Joint Apprenticeship Committee, provides training in nine different classes of work. The course of study is designed to produce all-round mechanics who will be assured work even in periods when specialists are not required. Another basic purpose is to train an adequate number of supervisors for future needs. *Boeing News*, May.

Airways and Airports

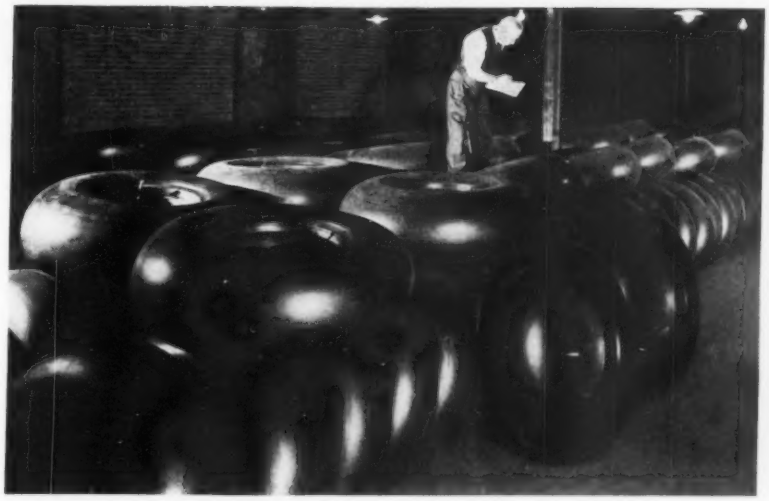
Administrator Connolly Discusses Airport Location Problems. One of civil aviation's current problems is how to get the best possible airports near to great cities, according to the Administrator of Civil Aeronautics. His correspondence on the subject is to be reproduced from time to time in the *Civil Aeronautics Journal* in order to promote an understanding of such problems.

This first letter in the series is addressed by Brig. Gen. Connolly to a New York woman who urged that drastic steps be taken to improve safety features at certain major airports such as Chicago and Detroit. *Civil Aeronautics Journal*, May 1.

A Labor Plan

No Bottleneck in Aviation. R. T. Frankensteen and Walter Smethurst. The director and the sub-director of the aviation division of the CIO United Automobile Workers view America's war effort as a "battle of production" and view a shortage of skilled help as a "bottleneck" in the aviation industry's defense program. In this 30-page booklet, they offer an analysis of present training problems. Their conclusions emphasize the amount of apprenticeship training they believe should be carried on in the aviation industry.

Training legislation of a mandatory character is suggested. Recommendations offered are twofold: "All men under training would be deferred from military conscription in order to serve the nation in the airframe and related industries. The men in training should be given free instruction, at government expense (NYA, CCC and other agencies), and the men should be given board and room plus a minimum of $1.00 per day." *UAW-CIO, International Education Department.*



A shipment of one hundred sets of 55 in., 210-lb. tires built by The B. F. Goodrich Company for the Army's Boeing B-17A bombers. These tires have a maximum load-carrying capacity of 25,000 lbs. each.

Rubber in Aircraft

B. F. Goodrich Airplane Tires, Brakes, De-Icers and Accessories. A 40-page catalogue of the more important B. F. Goodrich rubber products used in the modern airplane. Airplane tires are still the largest rubber unit in the average airplane. Their manufacture and inspection are described with some of the destruction tests to which sample tires are subjected in order to discover possible weaknesses. Data and specification sheets for low and high pressure airplane and tail wheel tires are given.

The new "expander tube" brake, adaptable to all types of aircraft, is explained with an analysis of such advantages as its lightness of weight, ease of adjustment and repair and uniformity of wear. Abrasion shields and cushions, shock chord, spark plug nipples and other rubber items are listed and described in addition to the rubber-based plastics and paints in common aircraft use.

A large section of the brochure is devoted to the design, theory, use and maintenance of the Goodrich de-icer system. The formation of ice on wings, empennages and propellers and its prevention by the use of the breathing type of de-icer to free the airfoil are explained. *The B. F. Goodrich Co.*

Bell History

Producer of Fighter Planes. Clinton R. Harrower. A brief historical sketch of the Bell Aircraft Company which started in 1935 to build a military airplane different from any previous model. Its first product was the twin-engined Airacuda. Later, the company's attention turned to the construction of the first American pursuit airplane carrying a 37 mm. cannon.

This article traces the first Army order back to 1939 when the initial service requisition for 13 airplanes was filed. Later, 80 more were ordered and more rapid construction got under way. This was followed shortly by a French Government order for 200, which were taken over by the British when France fell. A subsequent English order for 600 to 800 units necessitated the application of mass production methods.

This 10-page booklet, a reprint of part of a survey on the aviation industry made by the *Wall Street Journal*, outlines the expansion in plant space and production capacity at Bell, the extent of the training program it has set up and the specially designed machines it has acquired to enable the plant to make most of the 9,000 parts needed for the Airacobra. *Bell Aircraft Corporation.*

From the Ground Up

Lynn D. Gifford—Assembly Mechanic, Engine Expert, Serviceman. The problem of successful operation and meeting an accelerated production schedule at the new Niagara Falls plant of Bell Aircraft Corporation falls on the shoulders of Lynn D. Gifford, "veteran of aviation's infancy," who has been placed in complete charge of the plant. From freight clerk for a railroad *via* an automobile plant assembly line, Gifford progressed to aviation in 1915 when he joined the Curtiss Aeroplane Division. His background, embracing both airplane production and maintenance, is sketched in this vignette of Gifford and his career from the days of the "Jenny" to his present mass production job. *The Bellringer*, June.

Sylphon Bellows Catalogue

A catalogue on seamless metal bellows and bellows assemblies, commonly used in the manufacture of instruments, appliances and machinery. It indicates the fundamental applications of bellows, describing the roll-formed and hydraulically-formed bellows in single and multiply types.

The brochure discusses bellows metals, the action of bellows under load, their endurance qualities and life expectancy. Characteristics of brass, phosphor bronze, Everdur, Monel and steel bellows are described and their particular use in various industries including aviation are outlined. *The Fulton Sylphon Co.*

Dural Corrosion

Effect of the Quenching Rate on Susceptibility to Intercrystalline Corrosion of Heat-Treated 24S Aluminum Alloy Sheet. Hugh L. Logan. A study of the effect of the quenching rate of 24S aluminum alloy upon its behavior in an accelerated corroding solution of common salt, hydrogen peroxide and water. Specimens cooled from a temperature above 400°C. at a rate in excess of 815°–1,110°C. per sec. (increasing with the increasing copper content of the alloy) were found susceptible to the pitting type of corrosion.

Specimens cooled at a rate less than 300–400°C. (increasing with increasing copper content) and specimens cooled slowly to a temperature below 400°C. before quenching were subject to severe intercrystalline corrosion. For cooling rates between these ranges, there was a gradual change from one type of corrosion to the other. *Journal of Research of the National Bureau of Standards, Department of Commerce*, April.

Made-for-the-Job Tools

Multiplying the Output. Wherever special purpose tools can be developed and put to work, output can be multiplied rather than added to, as would be the case if additional slow-production machines and more trained men were the sole resource for expansion. The need for speed in producing aircraft and engines has led American industry to design and produce tools and machinery especially adapted to specific jobs and to find substitute time-saving methods to replace cumbersome operations. This phase of turning custom manufacture into mass production is briefly reviewed *Automobile Facts*, June.

Machining Practice

Machining Aluminum. A 32-page booklet designed to familiarize the machinist with the machining characteristics of aluminum and its alloys and with the up-to-date machining practices applied to the metal.

While the tools commonly used for cutting steel will perform satisfactorily on aluminum, the best results can be obtained by grinding more top and side rake on the cutting tools than is common for machining steel. Cutting edges should be kept sharp and free from burred or wire edges; a smooth, bright tool surface, free from scratches, should be maintained.

Part 1 of this booklet outlines the cutting angles and shapes of various tools for general machine shop practice. Cutting speeds, feeds, lubricants and tool materials are also discussed. Part 2 is concerned with speeds, feeds, cutting compounds, tool materials and various types of tools specifically used for screw machine practice. Included are tables on feeds for standard tools, the physical and mechanical properties of alloys, comparative weights of screw machine stock and general tolerances. *Aluminum Company of America.*

Brazilian Air Line

The Story of the Viacao Aerea Sao Paulo, S.A. VASP, as this airline is known, began in 1933 with a group of aviation enthusiasts in the State of Sao Paulo, Brazil. They formed VASP on a small scale with the object of establishing a number of airlines to link the capital of the State with Rio de Janeiro and with the commercial and production centers in the interior of Brazil. This article describes the rapid growth of one of Brazil's most important national airlines. *The Intava World*, April.

News Review

(*Continued from page 7*)

training facilities for 30,000 pilots a year.

May 28. President Roosevelt asked Congress for $2,329,936,785, principally for more airplanes for the Army and Navy, in order to bring total air strength to 50,000 airplanes.

May 29. More than 160 privately owned airplanes, purchased by the Reconstruction Finance Corporation on behalf of Great Britain, were reported awaiting shipment abroad for use in auxiliary service. Some of the larger airplanes were refitted to fly across the Atlantic.

May 30. The first class of 550 British flying cadets to be trained in the U.S. started work on June 7. Over 8,000 pilots and navigators will be instructed annually in this country for the R.A.F. Cost of the program is to be covered by allocations under the Lease-Lend Bill.

June 2. In an address delivered before the Annual Meeting of the National Aeronautic Association at Louisville, Col. John H. Jouett, president of the Aeronautical Chamber of Commerce of America, mentioned a proposal that long-range four-engined bombers deploy across the Atlantic on an airway 200 miles wide. Departing every hour on schedule and carrying heavy bombs, they could patrol a zigzag course over a convoy route with a fair chance of spotting and destroying surface and sub-surface raiders.

June 3. The Douglas, Vega and Boeing Aircraft companies announced they would pool their facilities for the production of a single type of large bomber, the Boeing B-17. Each plant would turn out the same design, identical and having interchangeable parts.

June 6. The Army Air Corps announced that it was organizing a ferry command to assist in flying aircraft from factories in this country to Britain. Col. Robert Olds has been placed in command of the unit.

June 7. Robert H. Hinckley, Assistant Secretary of Commerce, left London for Eire to discuss with Prime Minister Eamon de Valera the possibility of securing terminal facilities for a transatlantic service.

June 8. Col. F. Trubee Davison, former Assistant Secretary of War for Air, was recalled for active service by the Air Corps. He was to be assigned to G.H.Q. Air Force at Bolling Field.

June 10. More than 8,500 instructors and students, trained under the Civilian Pilot Training Program, were accepted by the Army and Navy air forces up to June 1, the Civil Aeronautics Authority reported.

June 10. Col. Frank M. Kennedy, Chief of Buildings and Grounds for the Army Air Corps, told the House Military Affairs Committee that the Army is already constructing underground hangars at important coast bases, one of the first and largest of these being at Borinquen Field, Puerto Rico.

June 10. Major General H. H. Arnold was awarded the General William Mitchell Trophy by Aviators' Post 743 of the American Legion.

From the Industry

Civil Aeronautics Administration

Announcements by Brig. Gen. D. H. Connolly, C.A.A. administrator, indicate that airport sites have been tentatively selected to be surveyed for possible airport construction or improvement work under the $94,977,750 appropriation to the C.A.A. for airport work. Of the appropriation, a total of $33,500,000 (to be supplemented by about $42,000,000 W.P.A. work) is for completion of the 250 airport program begun during the current year. The remaining $61,477,750 is to launch improvement work on the 149 additional airports which will be finally chosen on the basis of importance to national defense as soon as the preliminary survey is completed, or in about 30 days.

As in the 1941 program, the Federal funds will not be spent for land or buildings, but only for improvement of actual landing areas. Local political subdivisions will be required to provide suitable publicly-owned land, to construct whatever buildings are deemed necessary and to maintain and operate the airport. Federal funds will go into grading and drainage, paving of runways, etc.

Negotiations by the State Department with the Government of Portugal have resulted in establishment by the C.A.A. of regular radio communications with stations at Horta, the Azores, and Lisbon. C.A.A. releases indicate that the new service which began on June 1, gives station WSY at New York transatlantic connections and, added to the service with Bermuda and Newfoundland, gives coverage for both the northern and southern transatlantic routes. Beginning June 15, WSY also took over the radio beacon service previously maintained by the Pan American Airways System's New York station, WAQI.

WSY now operates four scheduled services with its associated ground stations, including transmittal between all stations of weather information on which weather maps and forecasts are prepared, and regular scheduled communications between the British stations at Newfoundland and Bermuda, and the Portuguese stations at Horta and Lisbon.

The station also carries on aircraft communications with planes flying the Atlantic along the northern route between Newfoundland and Ireland and the southern route *via* Bermuda, and is capable of handling aviation traffic anywhere in the North Atlantic. All messages are in international radio telegraph code, except that when planes arrive in the vicinity of New York voice communication is used.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Review.

To help meet the increasing volume of traffic due to greatly expanded civil and military air operations, 24,000 additional miles of teletype lines were added to the C.A.A. weather reporting system on July 1 according to the C.A.A. administrator. The new addition brings the weather reporting system to 55,000 miles, divided into two networks designated as schedules A and C. The new circuit, to be known as schedule C, will gradually take over from schedule A the work of disseminating the synoptic reports and forecasts, leaving the A circuit to handle the hourly and special surface weather reports. The third network, schedule B, comprises about 14,000 miles of lines which are used exclusively for airway traffic control.

Operations statistics for the 16 domestic air lines during the first four months of 1941 made public by the Administrator of Civil Aeronautics, show a 26 per cent increase in miles flown, 35 per cent in passengers carried, and 46 per cent in pounds of air express over the same period in 1940. The April figures indicate a substantial rise over April last year, particularly in pounds of express carried, comparison for the two years showing an increase of 55 per cent.

The new Washington National Airport was officially opened to traffic on June 15. C.A.A. reports describe facilities and services for both spectators and travelers to be very extensive. Equipment for handling traffic and accommodations for housing and maintenance of airplanes are reported to be of the latest types and capable of considerable expansion over present traffic. The airport is laid out so that parallel runways and a seaplane base can be installed at any time with little or no interruption of regular service.

Among special features of the airport are revolving turrets at each end of the Terminal Building, where weather information is collected and charted. In the control tower, one special device makes an automatic record of every conversation between the tower operator and pilots. Also used in the control tower is an innovation adapted from automatic stock quotation apparatus so as to flash on a board the location of all arriving and departing airplanes in the Washington Control Area.

Visual instruction to pilots for all landings is provided by a versatile system of field lights designed to aid the handling not only of air transports but particularly of planes not equipped with two-way radio communication.

On June 1, the appearance of a new map entitled Civil Airways of the United States and Canada heralded a new airways setup which groups Canadian and American facilities by redesignation and re-numbering of airways on both sides of the border. Transcontinental routes, for example, are now numbered from 1 beginning in the North with the Canadian transcontinental route and reading South. As soon as possible after July 1, all civil airways of the country are to be placed within the control of Airway Traffic Control centers. Nine new centers are to be added to the 14 already in operation, bringing the whole system under a unified control.

Aeronautical Chamber of Commerce of America

A survey by the Aviation News Committee revealed that a number of airplane and engine plants are employing

women shop workers at present. Aeronca, Beech, Boeing, Cessna, Culver, Curtiss, Douglas, Fairchild, Fleetwings, Hayes, Howard, Lycoming, North American, Porterfield, Solar, Taylorcraft, United Aircraft, Vultee and Wright Aeronautical are among these.

Only in recent months have women in any numbers been given the opportunity to participate in actual construction of military airplanes for the United States and Great Britain. Although most feminine aircraft workers are hired as seamstresses, to work on fabrics used for rudders, ailerons, upholstery, control surfaces, etc., more and more women are now proving that feminine dexterity can perform faster and more efficiently certain tasks formerly reserved for male workers.

Government studies have shown that women prove efficient and skillful in the machining and assembly of many of the small mechanical parts used in the construction of an airplane. Inspection is one of the departments in which women now play an important part, carefully checking—with the aid of intricate machines—the thousands of parts which go into each engine and airframe. One engine company, the Wright Aeronautical Corporation, reports its 60 young women inspectors test on an average of 32,760,000 parts in a year.

Sperry Gyroscope Co., according to the Aviation News Committee survey, is a pioneer in the employment of women in large numbers. Women are used not only for high-precision testing, but also for the assembling of delicate instruments so important to a pilot's safety.

Vultee Aircraft hires women for electrical sub-assemblies, masking in the paint department and operating drill presses. Beech Aircraft reports increased salvage when women are employed to sort bolts. Sewing and packing of parachutes is another task at which women excel. Several plants use feminine workers as packers.

Although few women are now working with drill presses, riveting machines and other shop machinery, indications are that as the industry continues its present program of expansion of floor space and personnel more and more women will be trained for actual production.

Air Transport Association of America

Col. Edgar S. Gorrell, president of the Air Transport Association of America, reported that a recent survey shows 85 per cent of today's air line travel to be for official or business purposes. A large part of the commercial travel, said Col. Gorrell, is applicable to national defense; the remaining 15 per cent is indeterminable and some of it also may have a bearing on the welfare of the nation.

Revenue passenger miles flown by domestic air lines in April amounted to 103,392,472, the fourth largest figure for any month and exceeded only during August, September and October of last year. Air express shipments also have increased appreciably, in part because of emergency needs for vital material and products.

Allison Division, General Motors Corp.

One hundred and seventy-five horsepower have been added to the Allison V-1710 liquid-cooled aircraft engine without increase in its size and with reduction of weight ratio to less than one pound per horsepower, according to announcements from the Allison Division. The company reports that the improved model, with over-all dimensions no larger than the Allison engines which the U.S. Army has been specifying for the past two years, has passed the test delivering 1,325 hp. at take-off and military rating against 1,150 hp., the top rating on Allison engines heretofore.

This 1,325 hp. engine weighs 1,303 lbs. dry, and involves no radical changes in parts from the 1,150 hp. model. The method by which the engine was improved cannot be disclosed, but it is said to be relatively simple. If machinery deliveries are made as required, Allison Division expects to more than double present production by the end of 1941. Buildings to house the additional machinery have been available for several months and the training of workmen is in progress.

Boeing Aircraft Company

Boeing Aircraft releases show that dispatches from Europe indicate zones of air action are on the move—up. Combat at 25,000 ft. and above is frequently reported and greater heights will undoubtedly become common as specially equipped types of aircraft such as the Flying Fortress come into wider service. But at 35,000 ft. pilots are on the threshold of the stratosphere where the air is so thin that a man will become unconscious in less than a minute without an artificial air supply. Conditions like these require careful training of flight crews—for test hops or military missions.

A program of "stratosphere conditioning," with the Strato-Chamber, a sealed tank that reproduces flying conditions at 35,000 ft., is being used for group training of flight crews for the extreme altitude test work being conducted by the Boeing Aircraft Company.

The tests are expected to yield important new data on the operation of Boeing's four-engined Flying Fortress bomber. These stratosphere-conditioning tests are being carried out on a large group. The flights to follow will be the first in which a whole crew of trained engineers has ever gone into the stratosphere to gather test data on the operation of turbo-superchargers under "flying laboratory" conditions.

The stratosphere-conditioning program, and the flights that will follow, are being conducted by the Boeing Flight and Aerodynamics department under the supervision of Edmund T. Allen, Director, and Al Reed, Chief Test Pilot. They are working closely with the Mayo Laboratory of Aviation Medicine in assembling special equipment and in mapping out procedures, and also with the General Electric Company, developers of the turbo-supercharger equipment.

The problem in training flight test crews for high altitude work is two-fold. Proper equipment must be assembled from many sources. Procedures must also be developed to guide crews in preparing for a flight, in handling their equipment during a hop, and in meeting any emergency. This type of flying is still so new that techniques or equipment details may change almost overnight.

As a result of the Strato-Chamber tests the Mayo Laboratory of Aviation Medicine has adopted completely the Boeing check-off list for stratosphere flight crews. This list is a step-by-step procedure for crews to follow in preparing for and during any flight above 25,000 ft.

Douglas Aircraft Company

Releases from Douglas Aircraft recently described the high-speed mechanized conveyor system being used at the Santa Monica plant to accelerate production of attack bombers and night fighters. Initiated last year, this streamlining of the production system, together with an expansion of 30 per cent in plant space and 70 per cent in employment, has resulted in nearly tripled production at the Santa Monica plant.

A 500-ft. elevated track conveys jigs containing wing assemblies which at regular intervals are borne down the line to the next working station. Automatic overhead crane-conveyors carry finished sub-assemblies to junction points where they are installed on fuselages that move on tracks along two parallel assembly lines. Assemblies are not even stopped for painting; they slide along their tracks through the paint shop and are camouflaged with spray guns as they pass.

These track production lines are said to have effected reductions of as much as 50 per cent in the man-hours required for certain assembly units. Throughout

he Douglas plant, fabricating departments and production lines have been streamlined and mechanized in every feasible manner. Through a timed conveying system, materials are delivered to each jig on a clocked schedule, and at regular intervals every unit the length of the assembly line moves down to the next station. Refinements and details of the mechanized production are being incorporated into the company's new blackout plant at Long Beach and have already been made available to the entire aircraft industry.

The General Tire and Rubber Company

A set of "two-in-one" rubber earphone cups, designed by Ray W. Brown, Manager of the aviation department of The General Tire & Rubber Company, was recently announced by that company. Made of treated latex to prevent chafing of the ears or head even after hours of constant wearing, the cups are worn in two ways—in an accordion fold which cushions against the head, or in a fold-back position to give a soft, but firmer contact.

The B. F. Goodrich Company

Ameripol, the new Goodrich synthetic rubber made by either the molded or lathe cut methods, is said by that company to be proving itself an efficient seal material for resisting petroleum derivatives. It was developed for various forms of gaskets and rings assembled with machines to keep oil or grease confined in bearings. Tests have shown that it does not swell in gasoline at room temperatures and that after immersion in oil for long periods it does not swell materially, but retains a high degree of flexibility and abrasion resistance.

The Cadillac Motor Car Division of General Motors Corporation, where Allison airplane engines are being manufactured for the Allison Division, reports that it has made extensive use of Goodrich Vibro-Insulators, devices of metal and rubber for insulation against vibration. The vibration eliminators were installed on machinery throughout the plant wherever vibration of adjacent machines on the production line proved an interference to effective operations.

Goodrich has announced a new product, called Conductor Industrial Tires, developed for pressed-on and vulcon types to prevent the accumulation of any charge of static electricity large enough to produce a spark when industrial trucks or tractors come in contact with other objects. Where such vehicles operate on cement, brick, stone or metal flooring, the new tires continually dissipate the static electricity, keeping the vehicle and the floor at the same electrical potential and eliminating fire and explosion hazard.

One of the first applications of the special compound used in these tires was for tail wheel tires for aircraft to bleed off static electricity, built up during the airplane's flight, upon contact of the wheels with the ground.

Koroseal, used extensively on combat airplanes, apart from other military and industrial applications, was placed on the Office of Production Management's mandatory priority list on June 9, according to an announcement by The B. F. Goodrich Company, which had several months earlier diverted substantially all Koroseal production to defense uses.

Used as an insulating and sheathing material for electrical wiring and cable, Koroseal's military value arises from its property of resistance to deterioration, oils, greases, water and sunlight. One important industrial application is its use to line pickling tanks for the production of stainless steel and non-tarnishable metals. Other forms of the product provide resistance to the diffusion of mustard and hydrogen gases. Three additional new plants for the production of Koroseal are expected to provide adequate production for all defense needs.

Interstate Aircraft & Engineering Corp.

The manufacturers of the patented machine gun charger being used on many American bombers built for the R.A.F. have developed and placed in quantity production a hydraulic machine gun charger for use on American military craft, according to announcement by Interstate Aircraft & Engineering Corp., which also manufactures the Cadet airplane. The hydraulic gun charger will be used on pursuit and attack airplanes, but names of the particular models have not been disclosed.

The Glenn L. Martin Company

First details of Britain's latest air weapon, the Martin 187 "Baltimore" medium bomber, were released June 19 by The Glenn L. Martin Company. Built around the express requirements of the Royal Air Force, as proved in modern air warfare, the Baltimore is reputed to be an exceptionally versatile airplane. In addition to its primary purpose as a medium bomber, it is designed for long-range reconnaissance missions and even to accept the gage of battle as a fighter. It is believed to be the fastest bomber of its class in the world and will carry heavy offensive and defensive firepower, including power-driven gun turret.

Lighter than the Martin B-26, the new medium-bomber being produced for the Army, the Baltimore is very much heavier than the 167 "Maryland" bombers, veterans of the Mediterranean fronts. It is a mid-wing, deep-waisted design powered with two Wright engines of 1,600 hp. each and carries a crew of four. It has an all-plastic nose, allowing wide visibility for the bombardier—a feature first introduced in the B-26, although the noses differ in appearance. Other interesting applications of plastics have been made in this airplane, although no details are available. Its landing gear is of the conventional type.

Following the precedent set by the B-26, the 187 has no prototype. The first airplane, now going through rigid tests, is a production airplane, with others following closely behind. Regular delivery schedules are expected to begin within a few weeks. Permanent, simplified and extremely accurate tooling has been set up for the manufacture of the bomber. By such methods the company saves many months in its production schedule. An entire building, with a total of nearly fifteen acres of floor space, not counting shop space, will soon be available for the assembly of this ship alone.

Piper Aircraft Corporation

C.A.A. approval on June 7 of the installation of plastic-plywood floats for the Piper Cub Trainer brings the utility and pleasure of water flying within reach of any private pilot and promises to greatly increase the popularity of this type of light plane, according to announcements by Piper officials. Production of the new pontoons is already underway by the National Trailer Co., at Elwood, Indiana where early deliveries will be available.

The new pontoons' ruggedness under adverse service conditions and their ease of repair in case of damage are practical advantages claimed for the new structure by the manufacturer. The floats have a displacement sufficient for an airplane of 1,300 pounds gross weight, but the Cub installation has a gross weight of 1,200 pounds and the rigid type of attachment gear developed by the Piper Company for installation on the Cub Trainer permits changing from wheels to floats in a very short time.

The floats are made of plastic phenol resin-bonded plywood, and a similar plastic resin varnish is used for sealing and finishing. In keeping with the standard Cub yellow on the Trainer, the floats are painted in the same fash-

Good News America!
YESTERDAY . . . the Martin B-26 broke records for getting into production—on new, high-efficiency equipment which quickly released a formidable stream of air power.
TODAY . . . with the new 1,181,000 square foot Army Building at Middle River about to move into production, the stream is swelling to a roaring torrent.
TOMORROW . . . with the completion of the 1,225,326 square foot Assembly Plant at Omaha, still more B-26's will be joining the Army in an overwhelming flood.
Martin's swiftly mounting production is GOOD NEWS for America!
Martin AIRCRAFT
Builders of Dependable Aircraft Since 1909
TRADE MARK
THE GLENN L. MARTIN COMPANY, BALTIMORE, MARYLAND, U. S. A.
LET'S GO! U.S.A.
KEEP 'EM FLYING!

ion. The design is simple and practical for rapid quantity production, the structure being an advanced semi-monocoque type with internal bracing which provides an extremely rigid and durable float that will withstand more than ordinary rough usage. Water-tight compartments, which are a feature of the internal structure, make for added safety in the operation of light planes equipped with these floats.

The Porcelain Enamel and Manufacturing Company

A new protective material, called Meltseel, has been announced by this company. It was developed to meet the increasing difficulty of obtaining heat-resisting alloy steels due to priority rulings. Meltseel is applied as a liquid coating to prevent corrosion and disintegration of metal parts exposed to gaseous atmospheres at furnace temperatures. It withstands heat in excess of 1,500°F., prevents oxidation and keeps the metal parts sound and clean.

Railway Express Agency

A recent analysis of increases in air express shipments since 1939 shows a 108 per cent gain in April over the corresponding month two years ago, according to Railway Express Agency. Heavy industry forwardings, including aviation materials, machinery, automobile and rubber goods, hardware and implements, shipyard materials and oil industry loadings, weighed an estimated 114½ tons.

By far the heaviest increase occurred in shipments to and from aircraft factories—287 per cent above the corresponding period in 1939. Gains in this and other heavy industries are due almost entirely to defense measures and consist largely of sub-assemblies, shortages, tools, instruments and drawings. Announcement by the War Department that the Army will speed national defense production by completing plans for additional air express shipments of emergency war materials is expected further to spur air express shipments.

Transcontinental & Western Air, Inc.

President Jack Frye reports that Transcontinental & Western Air, Inc., has just completed a program started last November for re-equipping its fleet of 30 Douglas DC-3 transports with a new and more powerful type of Wright Cyclone engine. The new engines, developing 1,200 hp. each, replace 1,100 hp. engines which were released by TWA to supply an urgent need for engines of that type in fighting planes being built for England.

Trans-Canada Air Lines

An extensive development of international air express by Trans-Canada Air Lines was announced by T.C.A., June 24, when air express service was opened between New York and the many points in Canada served by T.C.A. and the Canadian National Railways. The C.N.R. Express Department is handling the ground service work in Canada; Railway Express Agency is operating the ground service in New York. Three daily T.C.A. flights between New York and Toronto make possible shipments from New York to as far as Edmonton or Vancouver in little more than 14 hours.

Vultee Aircraft, Inc.

Production of military airplanes has been increased fourfold at the California plant of Vultee as a result of the powered mechanized final assembly line, as announced by company officials. Although the conveyor system is confined principally to the final assembly section, all parts production is so geared that every part used in the airplane may flow to its appointed assembly station on a strict schedule basis. Feeder lines of the conveyor reach out into various sub-assembly departments to carry the completed components into position on the final assembly line.

The 6,280 ft. overhead rail is designed so that the stations are free of machinery and obstructions, thus affording complete access to the airplane undercarriage at all times and increasing safety. Extensive steel supports are used to provide the necessary stability and rigidity for the conveyor. Powered sections are chain-driven and speed is controllable according to the output required. The rail system has numerous switches for rerouting of components along feeder and main assembly lines. Part supports on the carrier are of the sling type, the suspension arm type and the tray type.

The scheduling of flow and station operations was evolved by engineers through a thorough study of various combinations of machines and locations of departments, as laid out on a large board serving as a scaled replica of the entire factory.

In continuing its research activities in important production methods and processes, Vultee Aircraft has established a new unit, known as The Manufacturing Research Department, Vultee Aircraft, Inc. It will be under the general supervision of Don I. Carroll, vice-president in charge of production. The staff of the new department includes Peter Altman, head of the department and director of the activity, G. T. Gerlach, patent and research engineer and A. S. Kos, experimental engineer on manufacturing methods and processes.

Offices, an experimental shop and a laboratory have been established in Detroit, Michigan. It is planned that this department will move to new buildings at the Stinson Aircraft Division of Vultee at Wayne, Mich., when they are completed. The activities of the department are directly related to manufacturing methods and processes, materials and other research assignments of direct interest in aircraft manufacturing.

Willys-Overland Motors, Inc.

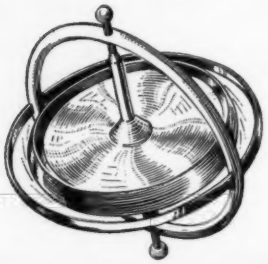
Large scale production of aluminum forgings, one of the most important links in the whole chain of parts needed for military aircraft construction, will be undertaken by Willys-Overland Motors, Inc., next fall, Joseph W. Frazer, president, announced recently. A loan of $2,172,000 from the Defense Plant Corporation, an RFC subsidiary, is being used to convert part of the Willys-Overland forge shop to aluminum work, with a capacity estimated at 40,000 pounds of forgings daily. Figuring potential output on the basis of three shifts a day, all hammers, 200 days a year, the Willys-Overland plant will increase the country's annual capacity for aluminum forgings by approximately 8,000,000 pounds.

All hammers will be interchangeable for steel or aluminum work, but those being newly installed will be in an air-conditioned unit to provide better working conditions for the exacting requirements of aluminum. When expansion is completed, 600 to 800 men will be employed in the Willys-Overland forge shop.

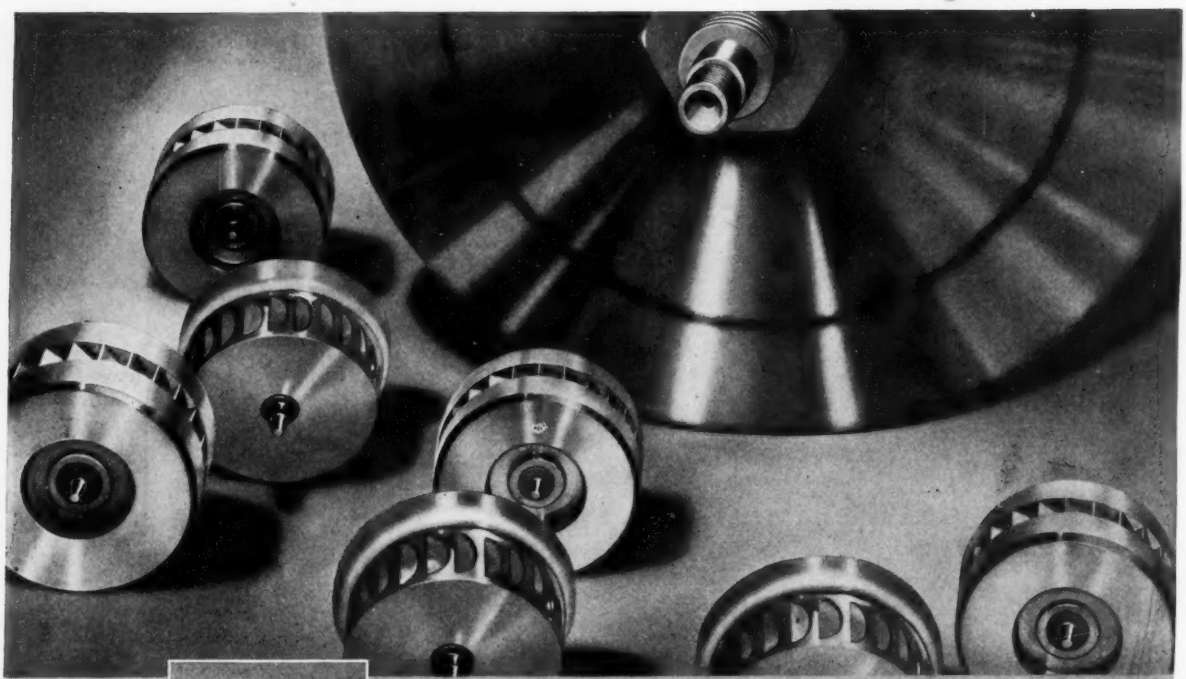
Special training is necessary because aluminum forging is more difficult. The new operator must acquire skill of eye and hand greater than that required in the working of steel before he can handle the low temperature aluminum work and get rapid "flow" of metal at around 850°F. For forgings of comparable size, aluminum requires hammers three times as powerful as steel, which can be heated to 2,000°F. for drop forge treatment.

A special machine shop for finishing work will be part of the company's new plant, and the aluminum forgings will be shipped to aircraft manufacturers in finished as well as unfinished form. It is understood that an initial order of $7,000,000 for aluminum aircraft forgings has been granted the company, although details on specific parts to be made have not yet been worked out.

WHAT A SPINNING TOP DOES



for National Defense



Aboard every major vessel in the United States Navy, the Army, the Coast Guard and the auxiliary services, in the cockpit of every Army and Navy combat plane, spinning tops are serving the National Defense. The natural phenomenon of the gyroscope has been harnessed to provide America with some of the finest navigational equipment in the world.

At sea, Gyro-Compasses — spinning tops of the highest order of perfection — have made possible *true north* navigation and the wonders of automatic steering. In the air, whirling metal rotors in the Directional Gyro, Gyro-Horizon and Automatic Gyropilot have revolutionized instrument flying.

Since Sperry put the spinning top to work thirty years ago, many Sperry developments which do not make use of the gyroscope have also achieved places of vital importance in the National Defense. They include the Anti-Aircraft Searchlight, the Sound Locator and the Universal Director.

SPERRY GYROSCOPE COMPANY, INC.

BROOKLYN SPERRY *NEW YORK*

Engine Cooling

A bibliography giving references for research in this specialized field. Revised and brought up-to-date from the fifty volume Bibliography of Aeronautics compiled and published with the cooperation of the Work Projects Administration from the Aeronautical Index of the I.Ae.S. References have been classified and cross-indexed.

AIR COOLING

1941

Aero Engine Cooling, by E. A. Smith; *Aeronautics,* June 1941, pages 51–53.

Cooling Characteristics of Submerged Light Aircraft Engines, by H. H. Ellerbrock; *S.A.E. Preprint National Aeronautic Meeting,* March 13, 14, 1941, 10 pages. (Abstract *S.A.E. Journal,* April 1941, page 25; and *Aviation,* May 1941, page 119.)

Air-Cooled vs. Liquid-Cooled Aircraft, by John G. Lee; *Journal of the Aeronautical Sciences,* April 1941, pages 219–229.

1940

Air Forces on Radial Air-Cooled Engine Cowling, by R. R. Higginbotham; *S.A.E. Journal,* September 1940, pages 370–396.

Laminar-Flow Heat-Transfer Coefficients for Ducts, by R. H. Norris and D. D. Streid; *A.S.M.E. Transactions,* August 1940, pages 525–533.

Cooling and Cowling, by D. L. Ellis; *The Aeroplane,* July 12, 19, 1940, pages 40–42; 73–75.

Controllable Cooling Gills; *Aircraft Production,* May 1940, pages 161–167.

The I.Ae.S. Annual Meeting; A Summarized Report of the Principal Papers Read during the Conference, by A. Klemin; *Aircraft Engineering,* May 1940, pages 143, 144.

Ein Einfaches Hilfsmittel zur Sichtbarmachung der Kuehlluftstroemung bei Luftgekuehlten Motoren, by H. Berndorfer and H. Thomas; *Luftwissen,* April 1940, pages 101–103.

"Submerged" Engine Installation; An Examination of Some of the Difficulties to Be Surmounted in Design and Installation, by Wellwood E. Beall and E. G. Emery, Jr.; *Aircraft Engineering,* April 1940, pages 106–108.

Aircraft Power Plants; *Flight,* February 8, 1940, pages 117–122.

Design of a Cooling System for Aero Engines Taking into Consideration the Compressibility of the Air, by V. G. Nikolsenko; *Aeronautical Engineering,* Moscow, February 1940, pages 52–66. (Air Ministry Translation No. 1100.)

Effect of Increased Finning of the Cylinders on Cooling of Air-Cooled Engines, by L. G. Sherimetev; *Aeronautical Engineering,* Moscow, February 1940, pages 34–51. (Air Ministry Translation No. 1056.)

Predetermination of Aircraft Engine Cooling Requirements for Specific Flight Conditions, by K. Campbell; *Journal of the Aeronautical Sciences,* February 1940, pages 141–147.

The Cooling of Aircraft Engines; *In Aircraft Engines,* Volume One, by A. W. Judge; D. Van Nostrand Company, New York, 1940, pages 241–321.

Cooling System Details; *In The Airplane and Its Engine,* by C. H. Chatfield, C. Fayette Taylor and Shatswell Ober; McGraw-Hill Book Company, New York, 1940, pages 211–220.

Das Widerstandsproblem der Flugmotorenkuehlung, by H. Helmbold; *Deutsche Akademie der Luftfahrtforschung,* Schriften 14, 1940, 14 pages.

1939

Operating Temperatures of Aircooled Engine Cylinders on French Transport Aircraft; *Automotive Industries,* December 1, 1939, page 572.

Low-Drag Engines; *Flight,* November 9, 1939, page 380.

Cooling and Cowling of Radial Engines, by L. Stipa; *Aircraft Engineering,* November 1939, page 422.

Progress in the Development of In-Line, Air-Cooled Engines, by A. T. Gregory; *S.A.E. Preprint for National Aircraft Production Meeting,* October 5–7, 1939, 26 pages.

Aircraft Engine Research of the N.A.C.A.; Finning of Cylinders and N.A.C.A. Close-Finned Cylinders, by Carlton Kemper; *Journal of the Aeronautical Sciences,* October 1939, pages 481, 482.

Aircraft Engine Research of the N.A.C.A.; Development of Cylinder with Greater Fin Area, by Carlton Kemper; *Journal of the Aeronautical Sciences,* July 1939, page 385.

Relative Fin Area of Some Air Cooled Engines; *Journal of the R.Ae.S.,* July 1939, page 555. (Also *Les Ailes,* May 5, 1939, page 7.)

A Cooling Development; *The Aeroplane,* June 14, 1939, page 764.

Il Raffreddamento e l'Incappottamento nei Motori Stellari, by L. Stipa; *L'Aerotecnica,* May 1939, pages 540–563.

Le Refroidissement Externe et la Surface des Ailettes; *Les Ailes,* May 7, 1939, page 7.

Cowling and Cooling of Radial Engines, by G. P. Douglas; *Journal of the R.Ae.S.,* March 1939, pages 258, 259.

Note sur la Mesure des Temperatures des Cylindres a Refroidissement par Air, by M. Bordet; *La Technique Aeronautique,* January-March 1939, pages 7–14.

Cooling on the Front of an Air Cooled Engine Cylinder in a Conventional Engine Cowling, by M. J. Brevoort and U. T. Joyner; Washington, U.S. Govt. Printing Off., 1939, 13 pages. (*N.A.C.A. Report No. 674.*)

Correction of Temperature of Air Cooled Engine Cylinders for Variation in Engine and Cooling Conditions, by Oscar W. Schey, Benjamin Pinkel and Herman H. Ellerbrock, Jr.; Washington, U.S. Govt. Printing Off., 1939, 24 pages. (*N.A.C.A. Report No. 645.*)

Design of N.A.C.A. Cowlings for Radial Engines, by George W. Stickle; Washington, U.S. Govt. Printing Off., 1939, 11 pages. (*N.A.C.A. Report No. 652.*)

Surface Heat-Transfer Coefficients of Finned Cylinders, by Herman H. Ellerbrock, Jr., and Arnold Biermann; Washington, U.S. Govt. Printing Off., 1939, 14 pages. (*N.A.C.A. Report No. 676.*)

1938

Cylinder Cooling and Drag of Radial Engine Installations, by Kenneth Campbell; *S.A.E. Journal,* December 1938, pages 515–528.

Qui a Inventé le Refroidissement sous Pression?; *Les Ailes,* October 6, 1938, page 7.

Le Refroidissement des Moteurs (a Refroidissement par Air) et la Resistance Aerodynamique, by P. E. Mercier; *La Science Aerienne,* September-October 1938, pages 153–179.

Le Refroidissement sous Pression, by M. Victor; *Les Ailes,* September 22, 1938, pages 7, 8.

Sternamotor mit neuartiger Kuehlhaube; *Zeitschrift des V.D.I.,* August 1938, pages 963, 964.

Cooling Developments; New French Schemes and Some General Conclusions; *Flight,* July 21, 1938, pages 62a, 62b.

Der Einfluss der Flughoehe auf die Flugmotorkuehlung, by Theodor Helmbold; *Luftfahrtforschung,* July 6, 1938, pages 354–367.

The Air Cooled Cylinder; Design of Aircraft Engine Components; *Automobile Engineers,* July 1938, pages 257, 258.

Un Nouveau Systeme de Refroidissement pour les Moteurs en Etoile, by P. E. Mercier; *Les Ailes,* June 2, 1938, page 8.

Refroidissement des Moteurs; *Les Ailes,* April 28, 1938, page 8.

Le Refroidissement par Air des Moteurs d'Aviation, by J. Delsuc; *L'Air,* April 20, 1938, pages 253–255.

Le Refroidissement par Air des Moteurs a Explosion; Les Recents Perfectionnements de Refroidissement par Liquide; Le Refroidissement par Air des Moteurs d'Aviation, by E. Ploix, J. Sylvestre and J. Delsuc; *L'Air,* April 1, 1938, pages 249–255.

Cooling the Gipsy Twelve; First Details of the New de Havilland Pressure-Duct System as Used on the Albatross; *Flight,* March 31, 1938, page 331. (Also *The Aeroplane,* March 30, 1938, page 391.)

Kuehlung eines Doppelsternmotors; *Flugsport,* March 16, 1938, page 12.

Energy Loss, Velocity Distribution and Temperature Distribution for a Baffled Cylinder Model, by M. J. Brevoort; *Automotive Industries,* February 12, 1938, pages 206–209.

Cooling Means for Aero Engines; *Aircraft Engineering,* February 1938, page 60.

Carenage et Technique du Refroidissement, by P. E. Mercier; *Le Genie Civil,* January 3, 1938, page 481.

Cooling Tests of a Single-Row Radial Engine with Several N.A.C.A. Cowlings, by M. J. Brevoort, G. W. Stickle and H. H. Ellerbrock, Jr.; Washington, U.S. Govt. Print. Off., 1938, 9 pages. (*N.A.C.A. Report No. 596.*)

Effect of Air Passage Length on Optimum Fin Spacing for Maximum Cooling, by M. J. Brevoort; Washington, 1938, 11 pages. (*N.A.C.A. Technical Note No. 649.*)

Heat-Transfer Processes in Air Cooled Engine Cylinders, by B. Pinkel; Washington, U.S. Govt. Print. Off., 1938, 16 pages. (*N.A.C.A. Report No. 612.*)

Ladeluftkuehlung, by W. Friedrichs; *Jahrbuch der Deutschen Luftfahrtforschung,* 1938, pages 311–314.

The Pressure Available for Ground-Cooling in Front of the Cowling of Air Cooled Airplane Engines, by George W. Stickle and Upshur T. Joyner; Washington, 1938, 9 pages. (*N.A.C.A. Technical Note No. 673.*)

Principles Involved in Cooling of Finned and Baffled Cylinders, by M. J. Brevoort; Washington, 1938, 12 pages. (*N.A.C.A. Technical Note No. 655.*)

Temperaturmessfluege von Flugzeugen mit Fluessigkeits—und luftgekuehlten Motoren vom Standpunkte der Betriebsicherheit aus betrachtet, by A. Seifert; *Jahrbuch der Deutschen Luftfahrtforschung,* 1938, pages 24–29.

Die Verbesserung der Kuehlverhaeltnisse bei luftgekuehlten Verbrennungsmotoren durch Versuche am Einzylindermotor, by H. Berndorfer; *Jahrbuch der Deutschen Luftfahrtforschung,* 1938, pages 276–280.

1937

Cooling Problems, by Richard M. Helsden; *Flight,* October 28, 1937, page 433.

Cooling of Radial Engines in Flight, by O. W. Schey and B. Pinkel; *Journal of the Aeronautical Sciences,* September 1937, pages 448–452.

Design for Metal Fins for Air Cooled Engines, by A. E. Biermann; *S.A.E. Journal,* September 1937, pages 388–392.

The Heat Transfer Processes in Air Cooled Engines, by B. Pinkel; *Journal of the Aeronautical Sciences,* August 1937, pages 403–410.

Cooling Ribs on Combustion-Chamber Wall; Effect of Different Metals and Coatings, by M. Serruys; *Automotive Industries,* March 13, 1937, pages 435, 436.

Cooling of Airplane Engines at Low Air Speeds, by T. Theodorsen, M. J. Brevoort and G. W. Stickle; Washington, U.S. Govt. Print. Off., 1937, 10 pages. (*N.A.C.A. Report No. 593.*)

The Cowling of Cooling Systems, by R. S. Capon; London, *H. M. Stat. Off.,* 1937, 23 pages. (*R. & M. No. 1702.*)

Energy Loss, Velocity Distribution and Temperature Distribution for a Baffled Cylinder Model, by M. J. Brevoort; Washington, 1937, 13 pages. (*N.A.C.A. Technical Note No. 620.*)

Heat Transfer from Cylinders Having Closely Spaced Fins, by A. E. Biermann; Washington, 1937, 28 pages. (*N.A.C.A. Technical Note No. 602.*)

Pressure Drop across Finned Cylinders Enclosed in Jacket, by V. G. Rollin and H. H. Ellerbrock, Jr.; Washington, 1937, 18 pages. (*N.A.C.A. Technical Note No. 621.*)

Il Raffreddamento ad Aria dei Motori d'Aviazione, by S. Storari and A. Tebaldi; *Atti Assoc. Ital. Aerotecn.,* 1937, page 34.

1936

Cooling Cylinders, by A. J. Rowledge; *Aircraft Engineering,* October, November, December 1936, pages 296; 324; 349.

Air Cooling Systems, by C. J. Stewart and F. W. Meredith; *Engineer,* November 13, 1936, page 533.

Refroidissement par l'Air des Moteurs de grosses Puissances; Etudes Gnome Rhone; Plein Ciel, September-October 1936, pages 23–26.

PRATT & WHITNEY, continued

MODEL: "Wasp" S1H1

A.T.C. No. 129

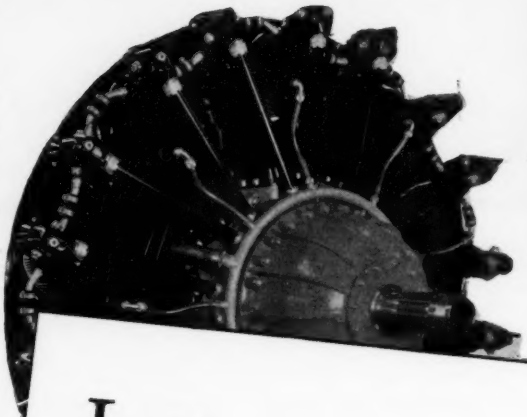
TYPE: Four cycle; Air cooled; Radial; Nine cylinders; Supercharged.

SPECIFICATIONS: Bore 5.75 in. Stroke 5.75 in. Displacement 1,344 cu. in. Compression ratio 6 to 1 Fuel 87 octane. Supercharger ratio 12 to 1. Weight 864 lb. Specific weight 1.56 lb./hp. Overall dimensions—diameter 51.75 in., length 48.94 in.

PERFORMANCE: Normal maximum rating 550 hp. at 2200 r.p.m. at 8,000 ft., take-off and Military (5 min.) rating at 6,200 ft. 600 hp. at 2250 r.p.m., cruising 400 hp. at 2000 r.p.m. at 11,800 ft. Fuel consumption .60 lb./hp-hr. (max.), .51 lb./hp-hr. (cruising). Oil consumption .025 lb./hp-hr. (max.), .015 lb./hp-hr. (cruising). B.m.e.p. 147 lb./sq. in.

CONSTRUCTION: Generally similar to "Wasp Jr." T1B3 except for size.

STANDARD EQUIPMENT: Same as "Wasp Jr." T1B3 except Bendix-Stromberg NA-Y9H carburetor. Provision for Hamilton Standard Hydromatic feathering propeller with two-position Hydro, adjustable



Hawker "Hurricane"

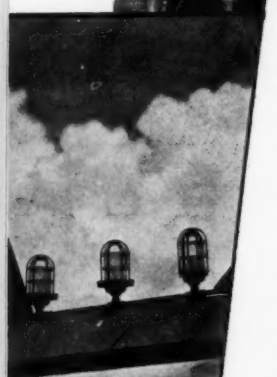
Aeroplane

STANDARD EQUIPMENT: Vide... absorbers. Dowty tail wheel un... Radiator below cockpit in... ght flying equipment. ... ion lights. Radio ... ment. Armament co... guns in wings.

TS: Standard equ... ents.

NCE: Maximum s... 500 ft. Landing speed ... ng 55,000 ft. Absolu... Rate of climb 2,40... mi. (5,000 ft. at 18...

Rolls-Royce "Merlin" II...) r.p.m. at 12,250 ft.



In World-wide Aviation's Biggest Year

AEROSPHERE·1941

INTERNATIONALLY RECOGNIZED AUTHORITY

...brings you a treasury of 933 airplane and engine photographs and illustrations along with definitive information on every conceivable phase of the *whole world's* aeronautical activities...*private, commercial and military.*

AEROSPHERE·1941 is published for the *dual purpose* of being a *useful daily working tool* in all branches of the aviation industry, and *completely informative to the alert lay reader* who wants full knowledge of today's greatest industry in terms of progress made, men, materials and military significance.

Here displayed for your inspection are sample pages (about ⅔ size) from the four major sections of AEROSPHERE·1941 indicating the clear, interesting and comprehensive treatment given the important branches of aeronautics.

NEW LOW PRICE $10 (plus shipping charges).

EVERYONE SHOULD HAVE WITHIN HIS REACH A COPY OF AEROSPHERE·1941, the indispensable aviation encyclopedial KNOW Aircraft and Engines of Italy, Germany, Great Britain, Japan, U. S. (and 21 other nations). RUSH THE COUPON!!

HERE'S WHAT CRITICAL REVIEWERS SAY OF AEROSPHERE:

Major General H. H. Arnold:
"Valuable contribution to the understanding."

Aviation:
"Well worth having."

New York Times:
"Most comprehensive and accurate single volume on aeronautics ever published."

Cleveland Plain Dealer:
"Veins of facts; chance to be an expert."

Air News:
"Clear, broad, accurate view of aviation in the world today."

U. S. Air Services:
"It should be on every library shelf."

PUBLISHED JUNE 11, 1941

AIRCRAFT PUBLICATIONS, 370 Lexington Ave., New York, N. Y.

Gentlemen: Please RUSH ..... volume(s) of AEROSPHERE·1941 ☐ Send me descriptive literature ☐

Name.....

Address.....

City.....*State*.....

ACCOUNTING MACHINES
International Business Machines

AIR COMPRESSORS
Brunner Manufacturing Co.
Champion Pneumatic Mach. Co.
Chicago Pneumatic Tool Co.
Curtis Pneumatic Machinery Co.
De Laval Steam Turbine Co.
The DeVilbiss Co.
Eclipse Fuel Engineering Co.
Gardner-Denver Company
Hobart Bros. Company
Ingersoll Rand Co.
Manley Manufacturing, Div. of American Chain & Cable Co., Inc.
Paasche Airbrush Company
Quincy Compressor Company
Romec Pump Company
Geo. W. Simons
Sullivan Machinery Company
U. S. Air Compressor Company
Worthington Pump & Mach. Corp.

AIR CONDITIONERS
Airtemp Division of Chrysler Corp.
Carrier Corp.
Fairbanks, Morse & Co.
General Refrigeration Corp.
B. F. Sturtevant Company
Surface Combustion Corp.
The Trane Company
Westinghouse Electric & Mfg. Co.
Worthington Pump & Mach. Corp.

AIR CONDITIONING AND COMMERCIAL REFRIGERATION EQUIPMENT
Claude Fan Co.
Curtis Pneumatic Machinery Co.

Scientific Instrument Co.
Stayner Filter Company
Sterling Tool Products Co.
Westinghouse Electric & Mfg. Co.

AIR FILTERS, COOLANT AND COMPRESSED
The Fostoria Pressed Steel Corporation

AIR FILTERS, ELECTROSTATIC
Air-Maze Corporation
Westinghouse Electric & Mfg. Co.

AIR HOSE
The Cleveland Pneumatic Tool Co.

AIRLINE EQUIPMENT
A. Schrader's Son

AIRPORT BUILDINGS
Independent Iron Works
International Derrick & Equipment Co.

AIRPORT CONTROL SYSTEMS
Airguide, Inc.

The Porter Company

AIR PUMPS
Brunner Manufacturing Co.
Curtis Pneumatic Machinery Co.
Ingersoll Rand Co.
Romec Pump Company

AIR REGULATORS
Sterling Tool Products Co.

AIR TEMPERATURE INDICATORS
Moto Meter Gauge & Equipment, Div. The Electric Auto Lite Co.

AIR TRANSPORT ASSOCIATION CHARTS
La Rue Printing Co.

AIR VELOCITY METERS
See Aircraft Accessories

ALKALINE PRODUCTS
The J. B. Ford Sales Co.

ANT
Triumph

APPROA FOR
Barrow

Richfield
Shell Oi
The To

ASPHALT AND BIDINGS
Barber Asphalt Corp.

ASPHALT (STABILIZING SOIL) (SURFACING RUNWAYS, HANGARS, APRONS, ETC.)
The Asphalt Institute

Cooling a Two-Row Radial Air Engine, by O. W. Schey and V. G. Rollin; *Automotive Industries*, August 29, 1936, pages 284, 285.

Performance of Air Cooled Engine Cylinders Using Blower Cooling, by O. W. Schey and H. H. Ellerbrock, Jr.; *Automotive Industries*, August 29, 1936, page 281.

A Revolution in Cooling; *Aircraft Engineering*, August 1936, page 212.

Airflow around Radiators and Effect of Cowling upon Drag and Cooling Power, by N. Nisiwaki and T. Kawaguti; *The Society of Naval Architects of Japan*, June 1936, pages 189–200.

Cowling and Cooling; *Flight*, April 16, 30, 1936, pages 400; 454–458.

Forced-Draft Cooling for an Air-Jacketed Engine, by A. S. Hartshorn; *Automobile Engineer*, February 1936, page 44. (Also *Mechanical Engineering*, December 1935, page 795.)

Wind Tunnel Investigation of the Cooling of an Air-Jacketed Engine, by A. S. Hartshorn; *Aircraft Engineering*, January 1936, page 26.

Air Flow around Finned Cylinders, by M. J. Brevoort and V. G. Rollin; Washington, U.S. Govt. Print. Off., 1936, 12 pages. (*N.A.C.A. Report No. 555.*)

Blower Cooling of Finned Cylinders, by O. W. Schey and H. H. Ellerbrock, Jr.; Washington, U.S. Govt. Print. Off., 1936, 12 pages. (*N.A.C.A. Report No. 587.*)

The Cooling and Cowling of Radial Air Cooled Engines; *Bristol Review*, June 1936, pages 27–33.

Cooling Characteristics of a Two-Row Radial Engine, by O. W. Schey and V. G. Rollin; Washington, U.S. Govt. Print. Off., 1936, 10 pages. (*N.A.C.A. Report No. 550.*)

Performance of Air Cooled Engine Cylinders Using Blower Cooling, by O. W. Schey and H. H. Ellerbrock, Jr.; Washington, U.S. Govt. Print. Off., 1936, 11 pages. (*N.A.C.A. Report No. 572.*)

1935

Messung der Stroemung an Luftgekuehlten Flugmotorenzylindern, by F. von Stotzinger and W. Seyerle; *Luftfahrtforschung*, November 28, 1935, pages 229–233.

Reducing Cooling Drag, by G. P. Douglas; *Flight*, November 21, 1935, pages 522, 524.

Cooling of Radial Engines, by J. M. Shoemaker, T. B. Rhines and H. H. Sargent; *Aircraft Engineering*, November 1935, pages 283–289.

Evaluation of Variables Influencing Air Cooling of Engines, by K. Campbell; *S.A.E. Journal*, November 1935, page 401–410. (Also *Automotive Industries*, June 22, 1935, page 837.)

Heat Transfer from Finned Engine Cylinders, by A. E. Biermann and B. Pinkel; *Power Plant Engineer*, July 1935, pages 400, 401.

Thurston Rotor Cowl for Air Cooled Engines; A New Method for Cooling and Reducing Head Resistance, by A. P. Thurston; *Journal of the R.Ae.S.*, May 1935, pages 445–447.

Cooling of Aircraft Engines, by F. W. Meredith; London, *H. M. Stat. Off.*, 1935, 13 pages. (*R. & M. No. 1683.*)

Heat Transfer from Finned Metal Cylinders in an Air Stream, by A. E. Biermann and B. Pinkel; Washington, U.S. Govt. Print. Off., 1935, 19 pages. (*N.A.C.A. Report No. 488.*)

The Heat Transfer of Cooling Fins on Moving Air, by Hans Doetsch; Washington, 1935, 40 pages. (*N.A.C.A. Technical Memorandum No. 763.*)

1934

Le Capotage et le Refroidissement des Moteurs en Etoile; *La Science Aerienne*, September-October 1934, pages 430–438.

Cooling of Finned Cylinders, by A. G. Biermann and B. Pinkel; *Journal of the Aeronautical Sciences*, October 1934, pages 178–185.

Cappottatura e Rafferddamento dei Motori d'Aviazione Raffeddati ad Aria; *Rivista Aeronautica*, July 1934, page 188.

N.A.C.A. Reaches Preliminary Conclusion on Fins and Baffles; *Automotive Industries*, June 30, 1934, page 816.

Engine Cooling Improved by the Use of a Controllable Cowl; *Aero Digest*, June 1934, pages 44, 45.

Cowling and Cooling of Radial Aircraft Engines, by R. B. Beisel, A. L. MacClain and F. M. Thomas; *Aircraft Engineering*, June, July 1934, pages 151–158; 197–200. (Also *The Aeroplane*, May 23, 1934, pages 840–843; *S.A.E. Journal*, May 1934, pages 147–166; and *Journal of the R.Ae.S.*, May 1934, pages 613–650.)

Cowling and Cooling, by O. E. Kirchner; *Aviation*, January 1934, pages 13–15.

Conduction of Heat through a Circular Fin, by M. Murata; *Journal of the Society of Aeronautical Sciences of Japan*, 1934, pages 361–370.

Wind-Tunnel Investigation of the Cooling of an Air-Jacketed Engine, by A. S. Hartshorn; London, *H. M. Stat. Off.*, 1934, 55 pages. (*R. & M. No. 1641.*)

Engine Cooling Research, by R. McKonnon Wood; *Journal of the R.Ae.S.*, September 1933, pages 733–744. (Also *The Aeroplane*, June 7, 1933, pages 1032–1034; and *Engineer*, May 17, 1933, page 272.)

1933

Aircraft Engine Cooling Problem, by Harold Camines; *Automotive Industries*, July 1, 1933, pages 14, 15.

Le Refroidissement des Moteurs; L'anneau Townend, by G. Ivanov; *La Conquete de l'Air*, April 1, 1933, pages 169, 170.

The Principles of Air Cooling, by D. R. Pye; *Aircraft Engineering*, February, April 1933, pages 31–33, 51–53; 79–86.

Conduction of Heat through Vertical Fin, by M. Murata; *Journal of the Society of Mechanical Engineers*, Tokyo, March 1933, pages 184–187.

Air Cooling in Theory and Practice; *Aircraft Engineering*, February 1933, page 26.

Development of Air Cooled Engines with Blower Cooling, by Kurt Lohner; Washington, 1933, 46 pages. (*N.A.C.A. Technical Memorandum No. 725.*)

Experiences sur le Refroidissement d'un Corps chaud par un Courant d'Air, by P. Vernotte and E. Blouin; Paris, Blondel la Rougery, 1933, 80 pages. (*Pub. Scient. Tech. Min. de l'Air No. 56.*)

1932

Experiments on Air Cooling; *Aviation Engineering*, December 1932, page 15.

Le Refroidissement des Moteurs d'Avion (par Air, par Eau, par Vaporisation, par Eau sous Pression, par Liquide a Point d'Ebullition Eleve), by J. Desgranges; *La Nature*, November 1, 1932, pages 394–397.

Om Flygmotor och deras Beraekning och Konstruktion, by H. Kryklung; *Tekniska Foeringen i Finland and Foerhandlingar*, November 1932, pages 298–305.

Il Problema de la Refrigeracion de los Motores de Aviacion de Enfriamiento por Aire, by G. Ivanov; *Revista de Aeronautica*, October 1932, pages 297–302.

La Technique des Cylindres de Moteurs a Refroidissement par l'Air, by G. Ivanov; *La Technique Automobile et Aerienne*, July-September 1932, pages 78–84.

Finning Air Cooled Cylinders, by E. L. Marks; *American Machinist*, April 7, 1932, page 468.

Le Nouveau Systeme d'ailettes Rossmeier Permettant d'ameliorer le Refroidissement des Moteurs; *Les Ailes*, March 31, 1932, page 4.

Some Points about Air Cooling, by Charles G. Grey; *The Aeroplane*, March 2, 1932, pages 376–378, 380.

Heat Dissipation from a Finned Cylinder at Different Fin-Plane Air Stream Angles, by O. W. Schey and A. E. Biermann; Washington, 1932. (*N.A.C.A. Technical Note No. 429.*)

1931

Suggestion pour le Refroidissement des Moteurs par Circulation d'Eau, by Corvette de Sales; *L'Aerotechnique*, October 1931, pages 353, 354.

Air Cooled Cylinder Head Design, by R. Chilton; *S.A.E. Journal*, September 1931, pages 185–191, 227.

Symposium of Views of Geared Down Radial Engines; *Aviation Engineering*, Washington, September 1931, page 26.

The Use of Air Cooled Engines for Civil Aircraft, by H. R. Fedden; *Aviation Engineering*, September 1931, pages 27, 29.

Les Progres des Moteurs d'Aviation a Refroidissement par Air, by G. Delanghe; *Le Genie Civil*, July 25, 1931, pages 84–87.

1930

Recent Developments in Cooling Aero-Engines; *The Aeroplane*, November 26, 1930, pages 1240, 1242, 1244.

Concerning Aircraft Engines, by L. D. Webb; Washington, U.S. Govt. Print. Off., November 1930, pages 19–22. (*Air Service Information Circular No. 11.*)

In Line Liquid Cooled versus Air Cooled Engines, by George J. Mead; *S.A.E. Journal*, August 1930, pages 143–147.

Rate of Heat Transfer from Finned Metal Surfaces, by C. Fayette Taylor and A. Rehbock; Washington, January 1930, 21 pages. (*N.A.C.A. Technical Note No. 331.*)

1929

An Analytical Review of the Engine Exhibit at Olympia, by N. E. Kearley; *Flight*, September 27, October 25, 1929, pages 1056a–1056c; 1140g–1140h.

Luftkuehlung bei Flugmotoren; Versuche ueber Waermebeherrschung und Leistungssteigerung in Flugmotorenzylindern mit Luftkuehlung, by F. Gosslau; *Zeitschrift des V.D.I.*, September 22, 1929, pages 1335–1340.

Effet de la Temperature ambiante sur le Fonctionnement des Moteurs a Refroidissement par Air, by M. Lehr; *Bulletin Technique du Bureau Veritas*, September 1929, pages 197–201.

Air Cooled Engines, by A. H. R. Fedden; *Times Trade and Engineering*, July 20, 1929, page 12.

Note sul Raffreddamento ad Aria dei Motori; *L'Ala d'Italia*, July 1929, page 657.

Air Cooled Engines in Service, by A. H. R. Fedden; *Journal of the R.Ae.S.*, April 1929, pages 269–318. (Also *Flight*, February 21, 28, 1929, pages 142–144; 169–173; and *The Aeroplane*, February 20, 1929, pages 261–269.)

The In Line Air Cooled Engine, by S. D. Heron; *S.A.E. Journal*, April 1929, pages 367–387.

Characteristics of Air Cooled Engines, by A. H. R. Fedden; *The Aeroplane*, February 27, 1929, pages 326, 327.

Drag and Cooling with Various Forms of Cowling for a Whirlwind Radial Engine, by F. E. Weick; Washington, U.S. Govt. Print. Off., 1929, 48 pages. (*N.A.C.A. Reports Nos. 315, 314.*) (Also *Notizario Tecnico di Aeronautica*, August 1929, pages 21–55; *The Aeroplane*, April 24, 1929, pages 653–656; *Aircraft Engineering*, April 1929, pages 58–60; and *Aviation*, February 16, 1929, pages 24–27.)

The Effect of Cowling on Cylinder Temperatures and Performance of a Wright J-5 Engine, by O. W. Schey and A. E. Biermann; Washington, U.S. Govt. Print. Off., 1929, 22 pages. (*N.A.C.A. Report No. 332.*)

1928–1916

Drag and Cooling with Various Forms of Cowling for a Whirlwind Engine in a Cabin Fuselage, by F. E. Weick; Washington, 1928, 25 pages. (*N.A.C.A. Technical Note No. 301.*) (Also *The Aeroplane*, December 5, 1928, page 912; *Airway Age*, December 1928, pages 56–61; and *Aviation*, November 17, 1928, pages 1556–1558, 1586–1590.)

Air Cooling; An Experimental Method of Evaluating the Cooling Effect of Air Streams on Air Cooled Cylinders, by J. F. Alcock; Washingon, 1927, 18 pages. (*N.A.C.A. Technical Memorandum No. 412.*)

Temperature Measurement of Motor Cylinder Walls, the Motors Being Air Cooled, by A. A. Dobrienin; *Tekhniko Vozdushnogo Flota*, January 1927, page 69.

Cooling of Air Cooled Engines by Forced Circulation of Air; Washington, 1926, 21 pages. (*N.A.C.A. Technical Memorandum No. 385.*)

Air Cooled Triumph; *Scientific American*, August 1925, pages 127, 128.

The Economy of Air Cooling, by K. J. Boedecker; *Aviation*, November 4, 1925, pages 492, 493.

Luftgekuehlte Flugmotoren, by F. Gosslau; *Zeitschrift des V.D.I.*, September 6, 1924, pages 921–925.

Radial Air Cooled Aero Engines, by A. H. R. Fedden; *The Aeronautical Journal*, April 1924, pages 260–267.

Mathematical Equations for Heat Conduction in the Fins of Air Cooled Engines, by Daniel Roberts Harper and W. B. Brown; Washington, U.S. Govt. Print. Off., 1923, 32 pages. (*N.A.C.A. Report No. 158.*)

In Defense of the Air Cooled Aircraft Engine, by S. D. Heron; *Automotive Industries*, July 7, 28, 1921, pages 30, 31; 181.

Methods of Cooling Airplane Engines, by Ludlow A. Clayden; *Automotive Industries*, June 16, 1921, pages 1292, 1293.

Heat Distribution in Aluminum Air Cooled Cylinders, by A. H. Gibson; London, *H. M. Stat. Off.*, 1921, 15 pages. (*I.C.E. Sub-Committee Report No. 10.*)

Temperatures and Temperature Distribution on 4½ Inch x 5½ Inch (R.A.F. 8T2) Aluminum Cylinder on Single Cylinder Air Cooled Engine, by A. H. Gibson; London, *H. M. Stat. Off.*, 1921, 6 pages. (*I.C.E. Sub-Committee Report No. 8.*)

Radiators and Cooling Systems for Aircraft Engines, by R. N. Liptrot; *Aeronautics*, April 29, May 6, 1920, pages 345–347; 364–366.

The Air Cooling of Petrol Engines; *Aeronautics*, February 19, 1920, page 159.

On the Shape of Fins for the Cooling of Hot Surfaces by a Stream of Air, by A. A. Griffith; London, *H. M. Stat. Off.*, 1920, 10 pages. (*R. & M. No. 308.*)

Resume of Experimental Work on Air Cooled Cylinders at the Royal Aircraft Establishment, by A. H. Gibson; London, *H. M. Stat. Off.*, 1920, 6 pages. (*I.C.E. Sub-Committee Report No. 41.*)

Test of Revisions in Cooling Systems for Air Cooled Cylinders; Washington, U.S. Govt. Print. Off., 1920, 18 pages. (*Air Service Information Circular No. 124.*)

Resume of Experimental Work on Air Cooled Cylinders at the Royal Aircraft Establishment, by A. H. Gibson; London, *H. M. Stat. Off.*, 1919, 12 pages. (*I.C.E. Sub-Committee Report No. 24.*)

Dear Mom:

Well, here it is another week-end and I'm not a General yet. But give me time.

Matter of fact, I have too much time on my hands—on evenings and weekends.

The nearest village is 5 miles away. All you find there is a general store, a garage and a canning factory—nowhere to go for any good clean fun, unless you drop in at a smoke-filled juke joint on the way.

Well, Mom, there's a big favor you can do me. The U. S. O. is trying to raise $10,765,000 to run clubs for us, outside of camp. Places with lounge rooms, dance floors, games, writing rooms. Places you can get a bite to eat without paying a king's ransom.

I know you don't have an idle million lying around, but if you could get the family interested and some of the neighbors, and if that happened all over the country, the U. S. O. could raise $10,765,000 overnight.

I'd appreciate it a lot, Mom, and so would every other mother's son in the U. S. Army and Navy.

Love,
Bill

They're doing their bit for you. Will you do your bit for them? Send your contribution to your local U. S. O. Committee or to U. S. O., Empire State Building, New York, N. Y.

OPEN YOUR HEART
OPEN YOUR PURSE
GIVE TO THE

U·S·O

UNITED SERVICE ORGANIZATIONS

These organizations have joined forces to form the U.S.O.: the Y.M.C.A., National Catholic Community Service, Salvation Army, Y.W.C.A., Jewish Welfare Board, National Travelers Aid Association.

THIS SPACE CONTRIBUTED BY THE BG CORPORATION

LIQUID COOLING

1941

Aero Engine Cooling, by E. A. Smith; *Aeronautics*, June 1941, pages 51–53.

Air-Cooled vs. Liquid-Cooled Aircraft, by John G. Lee; *Journal of the Aeronautical Sciences*, April 1941, pages 219–229.

Ford 1700 Hp. Engine to Be Liquid Cooled; *Automotive Industries*, February 15, 1941, page 178.

Thermostatic Control in Liquid Cooling, by W. Warfield; *Aero Digest*, February 1941, pages 150, 178.

Experimental Investigations of Freely Exposed Ducted Radiators, by W. Linke; Washington, 1941, 22 pages. (*N.A.C.A. Technical Memorandum No. 970.*)

1940

America Goes Wet Again; *The Aeroplane*, August 9, 1940, pages 155, 156.

Cooling and Cowlings, by D. L. Ellis; *The Aeroplane*, July 12, 19, 1940, pages 40–42; 73–75.

Closed Liquid-Cooling System for Aero-Engines, by A. E. Kuznetsov; *Vestnik Vozdushnogo Flota*, July 1940, pages 60–62.

High-Output Aero Engines; An Account of Recent Activities in the Development of Liquid-Cooled Engines, by E. W. Hives and F. Smith; *Aircraft Engineering*, July 1940, pages 194–201.

Radiator Research in the U.S.S.R.; Some Russian Investigations into the Problem of Wing Radiators; *Aircraft Engineering*, May 1940, pages 133–136, 146.

Freezing Points of the System Ethylene-Glycol-Methanol-Water, by F. H. Conrad, E. F. Hill and E. A. Ballman; *Industrial and Engineering Chemistry*, April 1940, pages 542, 543.

"Submerged" Engine Installation; An Examination of Some of the Difficulties to Be Surmounted in Design and Installation, by Wellwood E. Beall and E. G. Emery, Jr.; *Aircraft Engineering*, April 1940, pages 106–108.

Difluoridchlormethan als ein Kuehlmittel, by R. Plank; *Zeitschrift des V.D.I.*, March 9, 1940, pages 165–169.

Control of Liquid Cooling Systems of Internal Combustion Engines; *Engineer*, March 8, 1940, page 243.

High-Output Aircraft Engines, by E. W. Hives and F. Ll. Smith; *S.A.E. Journal*, March 1940, pages 106–117.

Aircraft Power Plants; *Flight*, February 8, 1940, pages 117–122.

La Technique Heinkel de Refroidissement par Vaporisation d'apres les Brevets du Constructeur; *L'Aeronautique*, February 1940, pages 51, 52.

The Cooling of Aircraft Engines; In *Aircraft Engines*, Volume One, by A. W. Judge; D. Van Nostrand Company, New York, 1940, pages 241–321.

Cooling System Details; In *The Airplane and Its Engine*, by C. H. Chatfield, C. Fayette Taylor and Shatswell Ober; McGraw-Hill Book Company, New York, 1940, pages 211–220.

Theoretical and Experimental Investigations of Drag of Installed Aircraft Radiators, by W. Barth; Washington, 1940, 11 pages. (*N.A.C.A. Technical Memorandum No. 932.*)

1939

Liquid-Cooled Engines, by A. G. Elliott; *Flight*, December 7, 1939, pages 464i–464L, 465.

Die Fluessigkeitskuehlung von Verbrennungsmotoren; *Automobiltechnische Zeitschrift*, November 10, 1939, pages 570–572.

Design of Airplane Ducts, by G. N. Patterson; *Aircraft Engineering*, July 1939, pages 263–268

The Influence of Speed on Heat Loss in Petrol Engines—Water Cooling, by W. T. Davis; *Engineer*, June 23, 1939, page 765.

La Technique du Radiateur, by L. Breguet and R. Devillers; *Les Ailes*, March 2, 1939, page 8.

The Development of Liquid Cooling, by W. W. Twelvetrees; *Aircraft Engineering*, March 1939, pages 107–110.

1938

La Technique des Radiateurs Carenes, by L. Breguet and R. Devillers; *La Science Aerienne*, November-December 1938, 98 pages.

Cocktails a l'Ethyl-glycol, by Maurice Victor; *Les Ailes*, November 3, 1938, page 7.

Le Refroidissement sous Pression; *Les Ailes*, September 22, 1938, page 7-8.

Aerodynamischer Widerstand eines Flugzeugkuehlers besonders in Bezug auf die Erwaermung der Luft, by B. Goethert; *Luftfahrtforschung*, September 10, 1938, pages 427–444.

Has the Liquid-Cooled Aircraft Engine a Future?, by Fritz Nallinger; *Germany and You*, August-September 1938, pages 254, 277.

A New Radiator Arrangement for Liquid-Cooled Engines; *Interavia*, August 13, 1938, page 4.

Cooling Developments; New French Schemes and Some General Conclusions; *Flight*, July 21, 1938, pages 62a, 62b.

Confronti fra Resultati Sperimentali e Teoretici Esistenti sulle Installazioni Radianti degli Aeromobili e loro Applicazione al Progetto ed all'Impiego in Volo delle Medesime, by R. Chiappulini; *L'Aerotecnica*, May 1938, pages 582–599.

Les Recents Perfectionnements de Refroidissement par Liquide, by J. Sylvestre; *L'Air*, April 20, 1938, pages 251, 252.

Le Refroidissement dans les Moteurs a Explosion; Les Recents Perfectionnements de Refroidissement par Liquide; Le Refroidissement par Air des Moteurs d'Aviation, by E. Ploix, J. Sylvestre and J. Delsuc; *L'Air*, April 1, 1938, pages 249–255.

Le Radiateur et l'Echappement Constituent une Phase Motrice du Moteur d'Aviation Moderne, by Maurice Victor; *Les Ailes*, March 31, 1938, pages 7, 8.

Comparison entre Differents Moteurs d'Aviation a Refroidissement par Liquide, by L. Keuleyan; *L'Aero*, January 7, 1938, 1 page.

The Conversion of Energy in a Radiator, by A. Weise; Washington, 1938, 14 pages. (*N.A.C. A. Technical Memorandum No. 869.*)

Experimenteile Untersuchungen an Freifahrenden Duesenkuehlern, by W. Linke; *Jahrbuch der Deutschen Luftfahrtforschung*, 1938, pages 281–292.

Herstellfragen beim Kuehlerbau, by M. Behr; *Jahrbuch der Deutschen Luftfahrtforschung*, 1938, pages 315–318.

A Survey of the Development of the Automobile Radiator and Its Application to Aircraft, by John Coltman; Wolverhampton, England, Whitehead Brothers, 1938, 75 pages.

Temperaturmessfluege von Flugzeugen mit Fluessigkeits- und luftgekuehlten Motoren vom Standpunkte der Betriebsicherheit aus betrachtet, by A. Seifert; *Jahrbuch der Deutschen Luftfahrtforschung*, 1938, pages 24–29.

1937

Modifications a Apporter aux Moteurs Refroids par l'Eau pour les Refroidir a l'Ethylene Glycol (Prestone); *L'Aeronautique*, Novmeber 1937, pages 266, 267

Cooling Problems, by Richard M. Helsden; *Flight*, October 28, 1937, page 433.

Innenkuehlung durch Wasser, by C. Mornhinweg; *Automobiltechnische Zeitschrift*, September 10, 1937, page 434.

Die Bestimmung des Widerstands und der Durchflussmenge von Kuehlern bei verschiedenen Einbauanordnungen, by W. Barth; *Luftfahrtforschung*, June 20, 1937, pages 300–303.

1936

Kuehler, by P. Spremberg and O. Weishaar; *Zeitschrift fuer Flugtechnik und Motorluftschiffahrt*, 1937, pages 66, 67.

Author's Conclusion to Discussion of Liquid Cooled Aero Engines, by H. Wood; *S.A.E. Journal*, July, October 1936, pages 267–287; 400–424. (Also *The Aeroplane*, July 22, 1936, pages 123–126.)

Liquid Cooled Air Engines, by H. Wood; *Automotive Industries*, June 27, 1936, pages 910, 911.

Ducted Radiators; The Theory of Low-Velocity Cooling, with a Basis for Calculating the Drag, by F. W. Meredith; Aircraft Engineering, August 1936, pages 218–220.

Note on Performance Data for Honey-Comb Radiators in a Duct, by A. S. Hartshorn; London, *H. M. Stat. Off.*, 1936, 21 pages. (*R. & M. No. 1740.*)

1935

L'Utilisation de l'Alcool comme Carburant Refroidissant dans les Moteurs d'Aviation; *L'Aerophile* December 1935, pages 368–371.

Liquid Cooled Engines Design and Application to High-Speed and Other Aircraft, by A. Graham Forsyth; *Journal of the R.Ae.S.*, June 1935, pages 449–493.

Motori d'Aviazione Raffreddati a Liquido; *Rivista Aeronautica*, February 1935, page 342.

Cooling of Aircraft Engines, by F. W. Meredith; London, *H. M. Stat. Off.*, August 14, 1935, 12 pages. (*R. & M. No. 1683.*)

Heat Dissipation of Ethylene Glycol Radiators and Comparison with Water Radiators, by C. A. Brown and F. G. Barlow; London, *H. M. Stat. Off.*, 1935, 45 pages. (*R. & M. No. 1696.*)

1934–1933

Liquid Cooled Aero Motors; *The Aeroplane* December 5, 1934, pages 689–692. (Also *Flight*, December 5, 1934, pages 1305–1307, 1309.)

Effect of Jacket Water Temperature on Engine Performance; *Journal of the Franklin Institute*, December 1933, page 776.

Air for Liquid Cooling; *The Aeroplane*, November 15, 1933, page 864.

Engine Cooling Research, by R. McKonnon Wood; *Journal of the R.Ae.S.*, September 1933, pages 733, 744. (Also *The Aeroplane*, June 7, 1933, pages 1032–1034; and *Engineer*, May 17, 1933, page 272.)

La Refrigeracion en los Motores de Aviacion por Liquidos o por Vapor de Aqua, by G. Ivanov; *Revista de Aeronautica*, August 1933, pages 434–437.

Aircraft Engine Cooling Problem, by Harold Camines; *Automotive Industries*, July 1, 1933, pages 14, 15.

The Effect on Engine Performance of Change in Jacket-Water Outlet Temperature, by E. A. Garlock and Greer Ellis; Washington, 1933, 11 pages. (*N.A.C.A. Technical Note No. 476.*)

Etude sur la Transmission de la Chaleur a l'Eau de Refroidissement dans un Moteur d'Aviation; Application a la Comparison des Carburants, by M. Champsaur; Paris, Dunod, 1933, 108 pages.

1932–1931

Le Refroidissement des Moteurs d'Avion (par Air, par Eau, par Vaporisation, par Eau sous Pression, par Liquide a Point d'Ebullition Eleve), by J. Desgranges; *La Nature*, November 1, 1932, pages 394–397.

What Is Needed in the Aircraft Engine, by Alexander Klemin; *Scientific American*, August 1932, page 107.

High Temperature Liquid Cooled Aircraft Engines, by Arthur Nutt; *Aero Digest*, March 1932, pages 36, 37, 90, 94.

Case for the Water Cooled Engine, by L. F. R. Fell; *Times Trade and Engineering Supplement*, January 30, 1932, page 449.

German Experiments with Chemical Cooling of Aircraft Engine, by Hanns Weidinger; *Aviation Engineering*, January 1932, pages 34, 35.

The Mechanical Difficulties of Prestone Cooling at 300°F. Outlet Temperature; Washington, U.S. Govt. Print. Off., 1932, 12 pages. (*Air Corps Information Circular No. 670.*)

Radiatorless Liquid-Cooling, by J. H. Geisse; *Aviation*, December 1931, pages 696, 697.

Sealed Liquid Cooling, by J. H. Geisse; *Automotive Industries*, September 12, 1931, pages 390, 391.

The Cooling of Engines; Experiments Undertaken to Show the Possibilities of High Temperature Liquid Cooling, by Arthur Nutt; *Aircraft Engineering*, July 1931, pages 172–174.

Influence of the Increase in Temperature of the Cooling Liquid upon the Work of Aviation Motors, by Z. Gekker; *Tekhnika Vozdushnogo Flota*, June 1931, pages 392–398.

Impiego del Glicol Etilinico per il Raffreddamento dei Motori, by Domenico Cosci; *Aeronautica*, May 1931, pages 334–338.

Prestone Cooling, by Arthur Nutt; *Aviation*, May 1931, pages 289, 290.

Recent Engine Cooling Developments, by Andrew Swan; *Aeronautical World*, May 1931, pages 12, 13. (Also *Journal of the R.Ae.S.*, March 1931, pages 179–206.)

1930

Le Refroidissement des Moteurs d'Avions par l'Ethylene-Glycol; *La Nature*, November 15, 1930, page 476.

Possibilities of the Liquid Cooled Aircraft Engine, by R. B. Beisel; *S.A.E. Journal*, October 1930, pages 403–407.

Chemical Cooled Engines, by Harold Camines; *Aviation Engineering*, August 1930, pages 13, 14.

In-Line Liquid Cooled versus Air Cooled Engines, by George J. Mead; *S.A.E. Journal*, August 1930, pages 143–147.

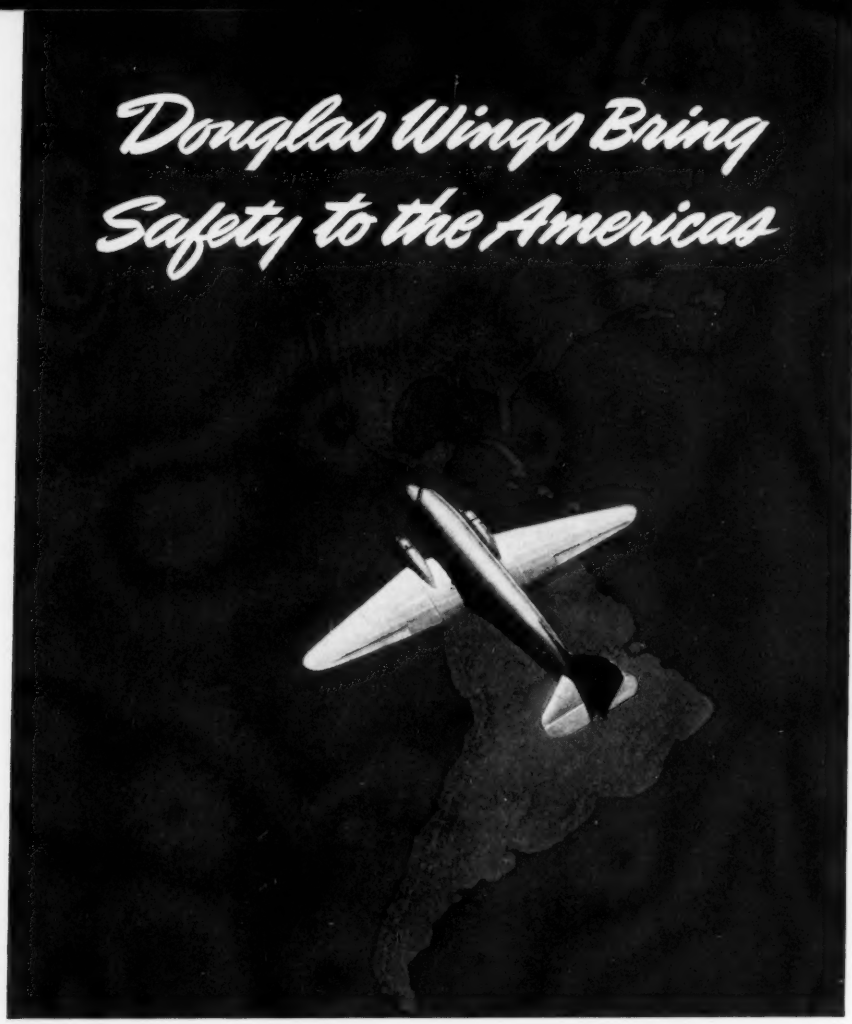
New Cooling Fluid for Airplane Engines; *Dun's International Review*, July 1930, page 66.

Water Cooled Aero Engines, by A. J. Rowledge; *Journal of the R.Ae.S.*, July 1930, pages 578–602. (Also *Automobile Engineer*, April 1930, pages 139–143; and *The Aeroplane*, March 5, 1930, pages 388, 390, 392.)

Refroidissement des Moteurs a l'Ethyleneglycol, by M. Lame; *L'Aerophile*, June 15, 1930, pages 180, 181.

British Water Cooled Aero Engines, by L. F. R. Fell; *The Aeroplane*, April 30, 1930, pages 791b, 793a–793c. (Also *Aircraft Engineering*, December 1929, pages 327–336.)

Douglas Wings Bring Safety to the Americas



17 AIRLINES GIVEN 1940 SAFETY AWARDS WITH AMERICAN AIRLINES, INC. HONORED FOR ONE BILLION SAFE PASSENGER-MILES

Among 17 airlines recently honored by the **National Safety Council** for operating throughout 1940 without a fatality, American Airlines, Inc. received an added grand award for 1,000,000,000 safe passenger-miles during the last five years. Douglas accounts for over 70% of the land planes used by the award winners and American Airlines' most notable safety record was made with 100% Douglas equipment. In addition to the foregoing awards, the **Inter-American Safety Council** presented its 1940 aviation award to Pan American Airways System and its affiliate, Pan American-Grace Airways for a perfect safety record of 113,200,630 passenger-miles in Latin America last year. Pan American is Douglas equipped and Pan American-Grace is Douglas 100%. Douglas Aircraft Co. Inc., Santa Monica, California.

DOUGLAS *first* IN AIRLINE SAFETY

These Major Airlines of the Americas are Douglas Equipped: American Airlines, Inc. . . Braniff Airways Canadian Colonial Airways . . . Catalina Air Transport . . . Chicago & Southern Air Lines . . . Delta Air Lines . . . Eastern Air Lines . . . Inter Island Airways . . . Northwest Airlines . . . Northeast Airlines Pan American Airways System . . . Pan American-Grace Airways . . . Pennsylvania-Central Airlines T.W.A. . . United Air Lines . . . Western Air Lines

Liquid Cooled Power Plants; *U.S. Air Services*, March 1930, page 42.

Le Refroidissement des Moteurs d'Aviation a l'Ethyl-glycol; *Le Genie Civil*, February 1, 1930, page 117.

High Temperature Liquid Cooling, by Gerhardt W. Frank; *Aeronautical World*, February 1930, pages 29–31, 73. (Also *Mechanical Engineering*, January 1930, page 63; *S.A.E. Journal*, October 1929, pages 329–343; *Western Flying*, October 1929, page 56; *Aviation*, June 1, 1929, pages 1877, 1878; and *The Aeroplane*, 1929, page 1069.)

Twenty-One Years of Water Cooled Engine Developments; *Flight*, January 3, 1930, pages 81–83.

Water Cooled Aero Engines, by A. Graham Forsyth; *Air Annual of the British Empire*, 1930, pages 366–392.

1929

An Improved Cooling System for Aircraft Engines, by A. M. Jacobs; *Air Corps News Letter*, Washington, November 29, 1929, pages 401, 402.

Nuovo Liquido Refrigerante per Motori; *L'Ala d'Italia*, November 1929, page 1064.

Motori Raffreddate a Mezzo del Glicol-etile; *Notizario Tecnico di Aeronautica*, October 1929, pages 154–159.

Moteurs Refroidis a l'Ethyl-glycol; *L'Aeronautique*, July 1929, page 252.

A New Cooling System, by Alexander Klemin; *Scientific American*, July 1929, page 70.

New Cooling Process for Water Cooled Engines; *Aero Digest*, June 1929, page 114.

Chemical Cooling of Aircraft Motors; *Aviation Engineering*, May 1929, page 14.

High-Temperature Cooling Agent Found in Ethylene-Glycol, by E. B. Neil; *Automotive Industries*, April 13, 1929, page 597.

Cooling Process for Aviation Engines; Loomis System; *Air Corps News Letter*, Washington, April 5, 1929, page 121.

Engine Cooling Fluid Developed by Army; *Aviation*, March 30, 1929, page 965.

Water Cooled Aircraft Engines, by James M. Shoemaker; *Aviation*, March 2, 1929, pages 638, 639.

A New Engine Cooling Process, by W. E. Gillmore; *U.S. Aviation Quarterly*, 1929, page 34.

1928–1919

Resistance and Cooling Power of Various Radiators, by R. H. Smith; Washington, U.S. Govt. Print. Off., 1928, 14 pages. (*N.A.C.A. Report No. 261.*)

Temperatura dell' Acqua di Circolazione nei Motori d'Aviazione in Alte Quota, by I. Raffaeli; *Rivista Aeronautica*, November 1926, pages 121–127.

Water Cooled Aero Engine, by A. J. Rowledge; *Automobile Engineer*, February 1924, pages 50–54. (Also *Engineering*, January 11, 1924, pages 59–62.)

Water Cooled Aero Engines; *The Aeroplane*, January 16, 1924, pages 56–58. (Also *Flight*, January 10, 1924, pages 23, 24.)

Cooling-System; Flight Test of TW-1 Airplane; Washington, U.S. Govt. Print. Off., 1924, 4 pages. (*Air Service Information Circular No. 410.*)

Air Flow in Relation to Water Cooling, by Ludlow A. Clayden; *Automotive Industries*, September 7, 1922, pages 462–466.

Cooling System Test of Lepere P-70 Equipped with Side Radiators; Washington, U.S. Govt. Print. Off., 1922, 8 pages. (*Air Service Information Circular No. 299.*) (Also *Aerial Age*, June 19, 1922, pages 343 344.)

Methods of Cooling Airplane Engines, by Ludlow A. Clayden; *Automotive Industries*, June 16, 1921, pages 1292, 1293.

Cooling System Flight Test of Loening M8; Washington, U.S. Govt. Print. Off., 1921, 8 pages (*Air Service Information Circular No. 206.*)

Cooling System Flight Tests of the VCP-1 with Annular Radiator; Washington, U.S. Govt. Print. Off., 1921, 3 pages. (*Air Service Information Circular No. 245.*)

Effect of Nature of Cooling Surface on Radiator Performance, by S. R. Parsons and R. V. Kleinschmidt; Washington, U.S. Govt. Print. Off., 1921, 10 pages. (*N.A.C.A. Report No. 87.*)

Report of Cooling System Flight Test of the Fokker D-VII with Mercedes Engines; Washington, U.S. Govt. Print. Off., 1921, 8 pages. (*Air Service Information Circular No. 233.*)

Report on Cooling System Test of Martin Bomber M-132–P-162; Washington, U.S. Govt. Print. Off., 1921, 6 pages. (*Air Service Information Circular No. 264.*)

Radiators and Cooling Systems for Aircraft Engines, by R. N. Liptrot; *Aeronautics*, April 29, May 6, 1920, pages 345–347; 364–366.

Wassergekuehlte Flugmotorenzylinder, by K. R. H. Praetorius; *Motorwagen*, April 30, 1920, pages 197–201.

Effect of Water Outlet Temperature on Engine Output; *Automotive Industries*, April 29, 1920, pages 1002, 1003.

European Aircraft Trend Is toward Water Cooled Engines; *Automotive Industries*, February 26, 1920, pages 554–559.

Radiators for Water Cooled Engines; London, *H. M. Stat. Off.*, 1920, 35 pages. (*R. & M. No. 407.*)

Results of Tests on Radiators for Aircraft Engines, by Hobart C. Dickinson; Washington, U.S. Govt. Print. Off., 1920, 34 pages. (*N.A.C.A. Report No. 63.*)

The Loomis Cooling System for Aircraft; *Aeronautics*, May 8, 1919, pages 479, 480. (Also *Mechanical Engineering*, March 1919, pages 255, 256.)

1918–1911

La Temperatura dell' Acqua nei Radiatori de, Motori di Dirigibili; *Rivista Marittima*, 1918i No. 3, page 120.

Wasserkuehlung bei Flugmotoren, by Willy Puels; *Technische Berichte*, December 20, 1917, pages 81–93.

Recent Discussion on Airplane Engines; *Power*, June 26,•1917, pages 871–874.

Preponderance of Water Cooled Aeroplane Engines; *Automotive Engineering*, September 1916, page 8.

Water Cooled Engines Predominate; *Aerial Age*, June 5, 1916, page 361.

Notes on Radiators for Aeroplanes, by J. C. Hunsaker; *Aerial Age*, May 29, 1916, pages 338, 339, 346.

Internal Water Cooling; *Aero*, April 1911, pages 19, 20.

STEAM COOLING

1941–1936

High-Temperature Cooling by the Vapor-Phase Method and Its Relation to Engine Performance and Wear, by J. H. Wallace; *S.A.E. Journal*, April 1941, page 159.

Evaporative or Steam Cooling; In *Aircraft Engines*, Volume One, by A. W. Judge; D. Van Nostrand Company, New York, 1940, pages 316–321.

Beitrag zur Theorie des Beheizten Duesenkuehlers, by H. Winter; *Luftfahrtforschung*, October 10, 1938, pages 500–504.

Heisskuehlung, by R. Schomerus; *Jahrbuch der Deutschen Luftfahrtforschung*, 1938, pages 271–275.

Le Refroidissement par Vapeur d'Eau des Moteurs d'Aviation, by M. Precoul; *Revue du Ministere de l'Air*, November 15, 1936, pages 1378–1382.

Un Tramonto; Il Raffreddamento a Vapore, by A. Silv; *L'Ala d'Italia*, April 1936, pages 56–58.

1935–1930

Steam Cooling, by Tarmac; *Aero and Airways*, December 1935, pages 106, 107.

Un Systeme Fairey de Refroidissement par Evaporation; *L'Aerophile*, May 1935, pages 146, 147.

Evaporative Cooling in Aircraft Engine; *Mechanical Engineering*, October 1934, page 625.

Evaporative Cooling, by R. Haley; *Flight*, March 29, April 26, 1934, pages 306g, 306h; 410a–410d.

Le Refroidissement des Moteurs d'Avion (par Eau, par Vaporisation, par Eau sous Pression, par Liquide a Point d'Ebullition Eleve), by J. Deagranges; *La Nature*, November 1, 1932, pages 394–397.

Le Refroidissement des Moteurs par Evaporation: *L'Aeronautique*, July 1932, pages 218, 219.

Versuche mit Heisskuehlung am Flugmotor, by Hanns Weidinger; *Zeitschrift fuer Flugtechnik und Motorluftschiffahrt*, September 28, November 28, 1931, pages 541–546; 664.

Recent Engine Cooling Developments, by Andrew Swan; *Aeronautical World*, May 1931, pages 12, 13. (Also *Journal of the R.Ae.S.*, March 1931, pages 179–206.)

1930–1916

Recent Developments in Cooling Aero Engines; *The Aeroplane*, November 26, 1930, pages 1240, 1242, 1244.

Heisskuehlung bei Verbrennungsmotoren, by E. Hecker; *Zeitschrift des V.D.I.*, April 12, 1930, pages 471, 476.

Le Refroidissement des Moteurs d'Avions par Evaporation, by G. du Bois; *La Conquete de l'Air*, February 1, 1929, pages 121–124.

The Evaporative Cooling of Aero-Engine, by T. R. Cave-Brown-Cave; *Engineering*, September 21, 1928, pages 369–375.

The Evaporative Cooling of Aero Engines and the Condensation of Exhaust Gas for Water Recovery, by T. R. Cave-Brown-Cave; *Journal of the R.Ae.S.*, January, March 1926, pages 30–69; 229. (Also *The Aeroplane*, November 11, 1925, page 566.)

British Tests Show Advantages of Steam Cooled Airplane Engines; *Automotive Industries*, December 31, 1925, pages 1108, 1109.

The Evaporative Cooling of Aircraft Engines, by T. R. Cave-Brown-Cave; *Automobile Engineer*, November 1925, pages 422–424.

Notes on Radiators for Aeroplanes, by J. C. Hunsaker; *Aerial Age*, May 29, 1916, pages 338, 339, 346.

COOLING—GENERAL

1941

Method of Computing the Dimensions of Airplane Engine Intercoolers, by J. Kendall Thornton and Joseph G. Beerer; *Journal of the Aeronautical Sciences*, May 1941, pages 292–297.

Paint Increases Heat Transmission in Engines, by M. A. Coler; *Power Plant Engineering*, May 1941, pages 83, 84.

Engine Cooling; Airplane Cylinders Cooler When Enameled, by M. A. Coler; *Scientific American*, April 1941, page 207.

High Power Aircraft Engines, by A. W. Judge; *Aeronautics*, March 1941, pages 48–54.

Propulsive Effects of Radiator and Exhaust Ducting, by Manfred Raucher and W. H. Phillips; *Journal of the Aeronautical Sciences*, February 1941, pages 167–174.

1940

Development of Sodium Cooling of Exhaust Valves; *Automotive Industries*, May 1, 1940, pages 417, 418.

Modern Aircraft Valves; Development of the Sodium-Cooled Valve, by A. T. Colwell; *S.A.E. Journal*, April 1940, pages 147–165.

Power Plants for Aircraft, by Harold Evans Hartney; *Western Flying*, February 1940, pages 19–22, 28.

Air or Liquid Cooled?, by John W. Morrison; *Flight*, January 11, 1940, page 39.

1939

Some New Investigations on Old Combustion Problems, by G. Eichelberg; *Engineering*, October 27, December 1, 1939, pages 463–466; 603–605.

Aircraft Engine Research of the National Advisory Committee for Aeronautics, by Carlton Kemper; *Journal of the Aeronautical Sciences*, October 1939, pages 479–484.

From France and England Come Engineering Data, by E. W. Hives and F. L. Smith; *Automotive Industries*, July 1, 1939, pages 22–24.

High-Altitude Flying Observations; Cooling, Supercharging Methods, Fuel Supply Methods, Power Plant Operation, by D. W. Tomlinson; *S.A.E. Journal*, July 1939, page 9.

Betrachtungen ueber den Hoehenflug, by Gunter Getzlaff; *Luftwissen*, June 1939, pages 197–203. (Abstract *Journal of the Aeronautical Sciences*, November 1939, page 35.)

Sixth Sense

TO FLY! Ability born to birds, denied to men.

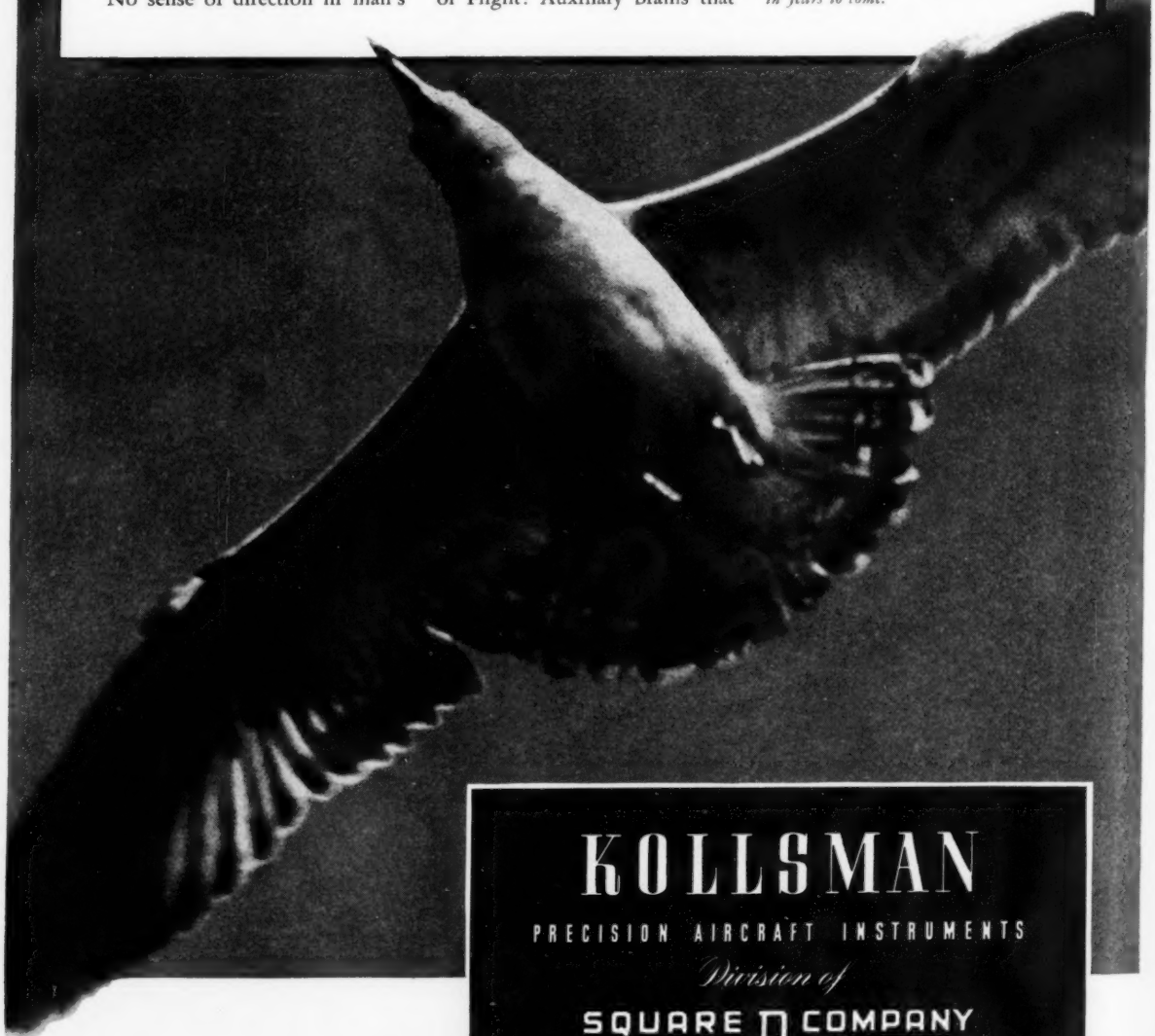
Yet wingless and featherless, man now flies truer than the birds themselves.

But no membrane of man's body tells him how high he is, when height means life itself.

No sense of direction in man's body tells him what track to take across the trackless sky. No nerve in man's brain can gauge that pulse of power from the hot heart of an airplane's engine.

Kollsman does! Kollsman Precision Aircraft Instruments, made with metals sensitive as nerves, give to man a Sixth Sense—that of Flight! Auxiliary brains that function with superhuman reliability at any height or speed, Kollsman Precision Instruments have come to mean Precision Flight in commercial, military, and private planes.

Economies being effected today by Kollsman's mass production methods perfected for national defense will benefit private and commercial aviation in years to come.



KOLLSMAN

PRECISION AIRCRAFT INSTRUMENTS

Division of

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA
DETROIT, MICHIGAN

Le Refroidissement des Moteurs d'Avions, by J. Lacaine; *La Nature*, March 1, 1939, pages 136–142.

The Effect of Nacelle-Propeller Diameter Ratio on Body Interference and on Propeller and Cooling Characteristics, by James G. McHugh and Eldridge H. Derring; Washington, U.S. Govt. Print. Off., 1939, 19 pages. (*N.A.C.A. Report No. 680.*)

1938

Flugmotorenkunde; Teil I: Grundsaetzlicher Aufbau der Motoren; Teil II: Hi fseinrichtung, Kuehlung; Schmierung; Getriebe, Brennstofforderung, Anlasser, by K. Schaefer; C. J. E. Volckmann Nachf., Berlin, 1939.

Cooling Deflector Design, by J. Engel; *Western Flying*, October 1938, pages 22, 23.

Systeme de Refroidissement du Piston, by S. D. Heron and B. Read; *La Technique Automobile et Aerienne*, October 1938, pages 159, 160.

Cooling Pistons; *Automobile Engineer*, September 1938, page 320.

Les Moteurs d'Aviation; Evolution et Tendances Actuelles, by Maurice Lame; *La Nature*, August 1, 1938, pages 70–76.

One Piece Suits; *The Aeroplane*, July 27, 1938, page 116.

Cooling Developments; *Flight*, July 21, 1938, pages 62a, 62b.

Der Einfluss der Flughoehe auf die Flugmoforenkuehlung, by Theodor Helmbold; *Luftfahrtforschung*, July 6, 1938, pages 354–367.

Liquid or Air; *The Aeroplane*, June 1, 1938, page 656.

La Refrigerazione dei Motori nei Reguardi della Potenza e del Consumo, by C. Gregorio; *L'Aerotecnica*, June 1938, page 750.

Refroidissement par Air ou par Liquide?; *L'Echo des Ailes*, March 17, 1938, pages 124–135.

Cooling Cylinders; Crankcases; *Aircraft Engineering*, January 1938, page 29.

Cooling, by A. Swan; In *Aero Engines, Design and Practice*, New York, Pitman Publishing Corporation, 1938, pages 271–324.

Kuehlungsfragen des Hoehenfluges, by R. Sabel; *Jahrbuch der Deutschen Luftfahrtforschung*, 1938, pages 257–270.

1937–1936

Improved Propeller Design Will Cool Airplane Engines; *Science News Letter*, Washington, October 30, 1937, page 284.

Le Refroidissement Interne Permettant d'Augmenter la Puissance Maximum des Moteurs, by M. Victor; *Les Ailes*, December 10, 1936, page 6.

Cylinder Temperature, by M. O. Teetor; *Oil and Gas Journal*, July 23, 1936, page 43.

Motori Raffreddata a Liquido o ad Aria?, by Plinio Piccardi; *L'Ala d'Italia*, July 1936, pages 61–67.

Engine Cylinder Heat Loss, by C. F. Taylor; *Journal of the Aeronautical Sciences*, June 1936, pages 282–286.

Results of Inadequate Cooling, by M. O. Teetor; *Automotive Industries*, May 30, 1936, pages 770, 771.

Cooling Cylinders; Siemens und Halske Aktien-Gesellschaft; *Aircraft Engineering*, April 1936, page 117.

1935–1931

Les Problemes de l'Aviation Stratospherique, by Rougeron; *L'Aeronautique*, July, August and September 1935, pages 187–194; 206–213; 249–254.

Evaluating the Variables Affecting the Cooling of Aircraft Power Plants; *Automotive Industries*, June 22, 1935, page 837.

Confronto fra Risultati Sperimentali e Teorici Esistenti sulle Installazioni Radianti degli Aeromobili e loro Applicazione al Progetto et all' Impiego in Volo delle Medisime, by Ruggero Chiappulini; *L'Aerotecnica*, May 1935, pages 582–599.

Current Problems in Airline Engines, by R. F. Gagg; *S.A.E. Journal*, February 1935, pages 50–57.

Protection of Cooling System from Corrosion in Internal Combustion Engines, by V. O. Krenig and S. Y. Pavlov; *Tekhnika Vozdushnogo Flota*, March-April 1933, pages 59–68.

Waermeuebergang und Zylinderwandtemperatur bei Heisskuehlung, by Hermann Oestrich; *Zeitschrift fuer Flugtechnik und Motorluftschiffahrt*, February 28, 1933, pages 109–114.

Les Hydravions de Course et le Probleme du Refroidissement des Moteurs, by H. Wendling; *L'Aeronautique*, July 1932, pages 205, 206.

Air or Liquid Cooling?; *Aircraft*, December 1931, page 30.

Flight Test on the Friedl Exhaust Valve Cooling System; *Aviation*, March 1931, page 186.

1930–1925

Sviluppi Recenti del Refrigeramento dei Motori d'Aviazione, by Andrew Swan; *Notiziario Tecnico di Aeronautica*, December 1930, pages 285–290.

Liquid Cooled In-Line versus Air Cooled Motors, by George J. Mead; *Aviation Engineering*, October 1930, pages 7, 8, 20. (Also *S.A.E. Journal*, August 1930, pages 143–147; *Aviation*, May 17, 1930, pages 984, 985; and *Automotive Industries*, May 1930, pages 753, 754.)

Motore per Alta Quota Autoraffreddatore, by L. Stipa; *L'Aerotecnica*, December 1928, pages 1037–1040.

Motor Cooling—Air or Water?, by E. E. Wilson; *Western Flying*, September 1928, pages 70, 71, 194.

La Distribuzione e le Oscillazioni della Temperatura nelle Parti Principali di un Motore d'Aviazione, by T. Suhara; Rome, *International Air Congress*, 4th, October 1927, V. 4, pages 349–357. (Abstract *Journal of the R.Ae.S.*, September 1928, page 817.)

Modern Airplane Power Plants; *S.A.E. Journal*, May 1927, page 536.

Air Cooled Fighters or Water Cooled, by F. W. Mead; *Aviation*, March 21, 1927, pages 565–567.

Fascicules Technologiques du Mecanicien d'Aviation; La Carburation et l'Allumage; Refroidissement, Graissage, Caracteristiques de quelques Moteurs d'Aviation, by Pierre Sauvanet; *Fascicules Professionnels de l'Ouvrier*, 1927, Nos. 6, 7, 32; 30 pages.

Moteurs d'Avions a Refroidissement par l'Air ou par l'Eau, by Jean Abel LeFranc; *La Nature*, April 24, July 10, 1926, pages 262–269; 20–24.

Piston Temperatures and Heat Flow in High Speed Petrol Engines, by A. H. Gibson; *Engineering*, January 29, February 5, 1926, pages 150–152; 183–185.

Water or Air Cooled Aero Engines?, by Ivar Malmer; IIIe *Congres International de la Navigation Aerienne*, 1925, V. 2, pages 407–414.

1924–1920

Des Plus Petits aux Plus Grands Moteurs d'Aviation, by C. Martinot-Lagarde; *L'Illustration*, December 13, 1924, pages 591–594.

Luftgekuehlte Flugmotoren, by F. Gosslau; *Zeitschrift des V.D.I.*, September 6, 1924, pages 921–925.

Self Cooling Aero Engines with Complete Expansion; *Popular Mechanics*, January 1923, page 91.

Cooling Experiments on R.A.F.-4A Cast Iron Cylinder, by A. H. Gibson; London, *H. M. Stat. Off.*, 1921, 4 pages. (*I.C.E. Sub-Committee Report No. 11.*)

Kuehlung und Kuehler fuer Flugmotoren, by D. Treffts and D. Prohlhausen; Berlin, R. C. Schmidt & Co., 1921, 200 pages.

Temperature Distribution in 100 mm x 140 mm Cast Iron Cylinders, by A. H. Gibson; London, *H. M. Stat. Off.*, 1921, 6 pages. (*I.C.E. Sub-Committee Report No. 9.*)

Die Kuehlung leichter Verbrennungsmotoren, by K. R. H. Praetorius; Berlin, M. Krayn, 1920, 281 pages.

1919–1909

The Cooling of the Aero Engine; Autocar, April 26, 1919, pages 609–612.

Should Aero Engines Be Air or Water Cooled; *Autocar*, December 11, 1915, pages 745–747.

Aeroplane Engines, by Neil MacCoull; *Aerial Age*, June 28, 1915, pages 346, 347. (Also *Transactions of the S.A.E.*, 1915, pages 143–186.)

Air vs. Water Cooling, by T. S. Harvey; *Flight*, December 7, 1912, page 1154.

The Cooling of an Aeromotor, by H. S. Rowell; *Flight*, April 23, 1910, page 303.

Un Nouveau Systeme de Refroidissement des Moteurs d'Aviation, by L. Durand; *L'Aeronaute*, January 22, 1910, pages 33, 34.

Die Kuehlung von Automobil und Flugmotoren, by F. Ernstes; *Zeitschrift des Mitteleuropaeischen Motorwagenvereines*, March 31, April 30, 1909, pages 113–123; 158–162.

Periodicals

(*Continued from page 30*)

Pictures in the Air. Charles Brown. Differing from aerial photography for military use, which requires vertical and oblique photos, the problem of pictorial photography from the air is likened to taking a portrait on the ground. The writer, one of the foremost photographers of aeronautical subjects, outlines the rules for taking pleasing pictures of aircraft in flight. He stresses the importance of logical composition as well as proper placement of the subject in relation to its background. *Aeronautics*, June 1941, pages 54–58, 11 illus.

This Corrosion Bug. James P. Ap-Roberts. Discussing corrosion as a maintenance problem, this article compares the degree and causes of corrosion on aircraft to corrosion on vehicles used in land and marine transportation. Various types of corrosion occurring on aircraft are described together with the methods currently in use for their prevention. *Aero Digest*, June 1941, pages 122, 123, 4 illus.

Schade-vergoeding bij luchtaanvallen (Compensation for Damages Caused by Air Attacks). An article on the English regulations on compensation to private citizens for damages due to air attacks. These regulations are very flexible, each case usually being considered individually. There are compensations for loss of life, disability of six months or less and disability of more than six months. Material damages are estimated by the authorities and compensated accordingly. *Luchtvaart*, April 22, 1941, page 160, 1 illus.

Electrical Installations. Gordon H. G. Garbett. A review of the complex electrical system of the modern fighting airplane. Beginning with a description of the generating methods the application of the direct engine and wind driven generators, the article outlines the wiring, radio shielding and lighting of the fighter craft.

The wiring of signal systems between members of the crew and between aircraft in formation indicates an interesting development in interplane communications. The electrical systems used in controlling the disposal of the bomb load further indicate the complexity of the bomber's wiring system. *Aeronautics*, June 1941, pages 68–70, 6 illus.

I Ferry a Luscombe. Robert F. Davis. Account of a cross-country flight from Washington, D.C., to Dallas, Texas, in a Luscombe. Airport and flying conditions en route are described and tables show relative speeds maintained and the cost of the trip. *Southern Flight*, June 1941.

EDO FLOAT GEAR

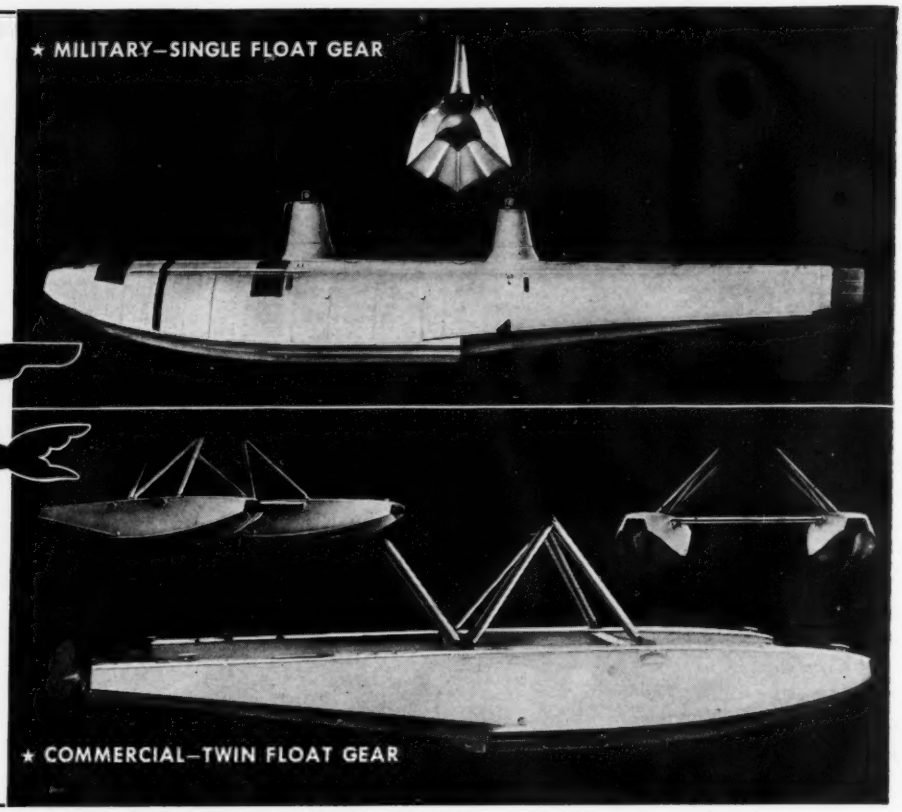
STANDARD THE WORLD OVER

EDO

EDO AIRCRAFT CORPORATION

Manufacturers of seaplane floats and float gear for military, commercial and private aircraft. Contractors to the U. S. Navy and Foreign Air Forces.

413 SECOND STREET
COLLEGE POINT, N.Y., U.S.A.



WITTEK

STAINLESS STEEL

HOSE CLAMPS FOR AIRCRAFT

Dependable—Proved by use in service, Wittek Hose Clamps are the standard equipment clamp of commercial and military Aircraft Manufacturers and the standard replacement clamp of the Industry. The quick tightening thumbscrew provides a balanced two side pull assuring a safe, leakproof connection under all conditions.

Wittek's new plant addition is equipped with a new research and test department and is adapted for increased production to the exacting standards of the Aircraft industry.

TYPE "FB"—A modern design for modern Aircraft is a solid band stainless steel hose clamp which combines light weight with greater strength and provides the most practical hose clamp for aircraft use.

MANUFACTURERS WRITE FOR FREE SAMPLE HOSE CLAMPS AND DESCRIPTIVE CATALOG

WITTEK MFG. CO. • 4305 W. 24th PL., CHICAGO

BOOTS . . . self-locking AIRCRAFT NUTS

are approved for construction of Army, Navy, and Commercial aircraft. Leading aircraft manufacturers are saving pounds and dollars by using improved Boots Aircraft Nuts wherever self-locking nuts are applicable.

Manufactured by
Scovill Mfg. Co., Waterbury, Conn.
United Carr Fastener, Cambridge, Mass.
for
Boots Aircraft Nut Corp., Waterbury, Conn.

ANOTHER SERVICE!

By special arrangement with publishers books may now be purchased by ordering them direct from the—

AERONAUTICAL ARCHIVES
of the
Institute of the Aeronautical Sciences

Those wishing to take advantage of this service may do so by sending a check or money order for any aeronautical book desired.

Make checks payable to

The Paul Kollsman Library
1505 RCA Building West 30 Rockefeller Plaza
New York, N. Y.

Aeronautical Review Directory of
Aircraft Products and Services

The companies listed in this directory contribute to the support of the Institute of the Aeronautical Sciences, the Journal of the Aeronautical Sciences and the Aeronautical Review through Corporate Membership dues or advertising or both.

The Institute will appreciate any consideration that members and subscribers can give to the products or services of these companies. It will be glad to assist in obtaining complete information on listed or any other products or services not included.

ADHESIVES

Bakelite Corporation
U.S. Plywood Corporation

AIRCRAFT

Airplane Division (Buffalo Plants), Curtiss-Wright Corporation
Airplane Division (St. Louis Plant), Curtiss-Wright Corporation
Boeing Aircraft Company
Consolidated Aircraft Corporation
Douglas Aircraft Company
Duramold Aircraft Corporation
Engineering & Research Corporation
Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation
Fleetwings, Inc.
Goodyear Aircraft Corporation
Grumman Aircraft Engineering Corporation
The Intercontinent Corporation
Lockheed Aircraft Corporation
The Glenn L. Martin Company
North American Aviation, Inc.
Northrop Aircraft, Inc.
Republic Aviation Corporation
Stinson Aircraft Division, Vultee Aircraft, Inc.
Vega Airplane Company
Vought-Sikorsky Aircraft Division, United Aircraft Corporation
Vultee Aircraft, Inc.

AIR TRANSPORTATION

American Airlines, Inc.
Northwest Airlines, Inc.
Pan American Airways System
Transcontinental & Western Air, Inc.
United Air Lines Transport Corporation

ALTIMETERS

Kollsman Instrument Division, Square D Company
Pioneer Instrument Division, Bendix Aviation Corporation

ALUMINUM

Aluminum Company of America

BATTERIES

The B. F. Goodrich Company

BEARINGS

Norma-Hoffmann Bearings Corporation

BOOKS (TECHNICAL)

Aero Publishers, Inc.
Aircraft Books, Inc.
Aircraft Specialties, Inc.
Theo. Audel and Company
Aviation Press, Inc.
Funk & Wagnalls Co.
Noble and Noble, Publishers
Pan American Navigation Service
Pitman Publishing Co.
Reinhold Publishing Corporation
Ronald Press, Inc.
Thompson Aviation Publishers, Inc.
Weems System of Navigation
John Wiley and Sons, Inc.

CAMERAS & SUPPLIES

Fairchild Aviation Corporation

CARBURETORS

Bendix Products Division, Bendix Aviation Corporation

COLLECTOR RINGS

Edward G. Budd Manufacturing Company
Thompson Products, Inc.

COMPASSES

Bendix Radio Corporation
Fairchild Aviation Corporation
Kollsman Instrument Division, Square D Company
Pioneer Instrument Division, Bendix Aviation Corporation
RCA Manufacturing Company
Sperry Gyroscope Company
Weems System of Navigation
Weston Electrical Instrument Company

COMPOUNDS (CLEANING)

Oakite Products, Inc.

CONTROLS & ASSEMBLIES

Breeze Corporations
Pump Engineering Service Corporation
Simmonds Aerocessories, Inc.
S. S. White Dental Mfg. Company
Sperry Gyroscope Company
Vega Airplane Company

COOLERS (OIL)

Edward G. Budd Manufacturing Company

CORD (SHOCK)

The B. F. Goodrich Company

COWLS

Airplane Division (Buffalo Plants), Curtiss Wright Corporation
Edward G. Budd Manufacturing Company
Vega Airplane Company

DE-ICER EQUIPMENT

Eclipse Aviation Division, Bendix Aviation Corporation
The B. F. Goodrich Company
Pump Engineering Service Corporation

INSTRUCTION

Boeing School of Aeronautics
Casey Jones School of Aeronautics
Weems System of Navigation

ENGINES

Jacobs Aircraft Engine Company
Lawrance Engineering and Research Corporation
Lycoming Division, Aviation Mfg. Company
Packard Motor Car Company
Pratt & Whitney Aircraft Division, United Aircraft Corporation
Ranger Aircraft Engines Division, Fairchild Engine and Airplane Corporation
Wright Aeronautical Corporation

EXPORTERS

Aviation Equipment and Export, Inc.

FABRICS

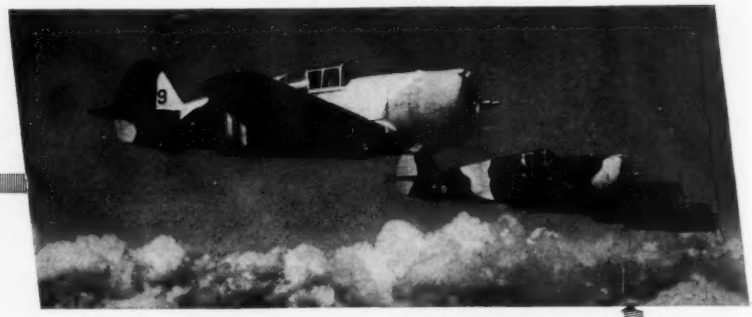
Wellington Sears Company

FASTENERS

Boots Aircraft Nut Corporation
Eaton Manufacturing Company
Elastic Stop Nut Corporation
Simmonds Aerocessories, Inc.
Thompson Products, Inc.
Tinnerman Products, Inc.

FITTINGS (STRUCTURAL)

Edward G. Budd Manufacturing Company
Elastic Stop Nut Corporation
Vega Airplane Company



America ROARS ahead on SHELL

FASTER, faster, faster, speed our planes. The top speeds of today will be the cruising speeds of tomorrow.

Playing a major part in the development of American Aviation is 100 octane gasoline—produced commercially for the first time by Shell. This is the fuel that has made American military ships unexcelled in performance, speed and flying range. No wonder those who know flying, "go" for Shell Aviation Products—proved by experts, and preferred by pilots everywhere.

SHELL OIL CO., INC., 50 WEST 50TH STREET, NEW YORK, N. Y. OR, 100 BUSH STREET, SAN FRANCISCO, CAL.

SHELL AVIATION GASOLINE

SHELL AVIATION PRODUCTS

AEROSHELL OIL

WORLD'S GREATEST all around ELECTRIC TOOL

DRILLS—GRINDS—SANDS
SAWS—POLISHES
SHARPENS—CARVES

ONLY $7.95 POSTPAID GUARANTEED FOR ONE YEAR

The new WHIZ ELECTRIC TOOL is the handiest power tool ever made. A rugged tool for power and precision work. Drills through 1/4 inch iron plate in 42 seconds or engraves intricate designs. Handles any material: Metals—Woods—Alloys—Plastics—Glass—Steel—etc. Saves time. Eliminates labor. Plug into any socket AC or DC, 110 volts. Chuck 1/4 inch capacity. Ball bearing thrust. Powerful, triple-geared motor. STANDARD MODEL, with Normal Speed (uses 200 different accessories, instantly interchangeable). **Price only $7.95.**

The only DRILL-TOOL with a full year's guarantee

FREE Accessory outfit (Value $2) includes set of drills, mounted 1½ inch grinder, sanding discs, cutting wheels, mounted brush, polishing wheel, carving burr, etc. FREE with each tool ordered NOW. We pay postage.

10-DAY TRIAL—MONEY BACK GUARANTEE

PARAMOUNT PRODUCTS CO.

Dept. 7-AER 545 Fifth Ave. New York, N. Y.

Are You a "Pick-Up" Reader of the

AERONAUTICAL REVIEW

Instead of a Regular Subscriber?

Every magazine worthy of the name has "pick-up" readers. That's the way magazines become known to new readers and the way a publication makes new friends.

Regular reading of the REVIEW by the "pick-up" reader method may wear pretty thin after a while .... Because of the documentary value of the AERONAUTICAL REVIEW, you should have a personal copy to gain the fullest benefit. You will see by the rates below that it costs little. The AERONAUTICAL REVIEW is packed with important information—and we mean packed, because it's a boiled-down compilation of aeronautical information gathered from world-wide sources.

Mail Your Subscription Now

Special Rate—3 years for $5.00
or
2 years for $4.00 1 year for $2.50

Make checks or money orders payable to

THE AERONAUTICAL REVIEW
1505 RCA Building West New York City

FLOATS & SKIS

Edo Aircraft Corporation
Goodyear Tire & Rubber Company, Inc.

FLOORING

Simmonds Aerocessories, Inc.

FORGINGS

Edward G. Budd Manufacturing Company
Thompson Products, Inc.
Wyman-Gordon Company

FUEL & HYDRAULIC SYSTEMS

Bendix Products Division, Bendix Aviation Corporation
Eclipse Aviation Division, Bendix Aviation Corporation
Pump Engineering Service Corporation

FUELS & OILS

The Pure Oil Company
Shell Oil Company
Socony-Vacuum Oil Company
Standard Oil Company of California
Standard Oil Company (Indiana)
Standard Oil Company of New Jersey
The Texas Company

GEAR BOXES (ACCESSORY DRIVE)

Pump Engineering Service Corporation

GENERATORS

Lawrance Engineering and Research Corporation
Westinghouse Electric & Manufacturing Company

HOSE (RUBBER)

The B. F. Goodrich Company
Goodyear Tire and Rubber Company, Inc.

HOSE CLAMPS

Wittek Manufacturing Company

INSTRUMENTS (AIRCRAFT)

Cambridge Instrument Company
W. & L. E. Gurley
Impact Register Company
Kollsman Instrument Division, Square D Company
Minneapolis-Honeywell Regulator Co., Inc.
Pioneer Instrument Division, Bendix Aviation Corporation
Simmonds Aerocessories, Inc.
Sperry Gyroscope Company
Westinghouse Electric and Manufacturing Company
Weston Electrical Instrument Company

INSTRUMENTS (ENGINE)

Eclipse Aviation Division, Bendix Aviation Corporation
Cambridge Instrument Company
Kollsman Instrument Division, Square D Company
Simmonds Aerocessories, Inc.
Weston Electrical Instrument Company

INSTRUMENTS (METEOROLOGICAL)

Julien P. Friez & Sons Division, Bendix Aviation Corporation
W. & L. E. Gurley
Kollsman Instrument Division, Square D Company
Simmonds Aerocessories, Inc.

INSURANCE

Associated Aviation Underwriters
Aero Insurance Underwriters
United States Aviation Underwriters

LANDING GEAR

Bendix Products Division, Bendix Aviation Corporation
Cleveland Pneumatic Tool Company
Thompson Products, Inc.

LIGHTS & ACCESSORIES (AIRPORT, AIRWAY)

Westinghouse Electric and Manufacturing Company

MAGNETOS

Scintilla Magneto Company

MANIFOLDS (EXHAUST)

Airplane Division (Buffalo Plants), Curtiss-Wright Corporation
Edward G. Budd Manufacturing Company
Vega Airplane Company

METALS (STRUCTURAL)

Aluminum Company of America
American Rolling Mill Company
Climax-Molybdenum Company
Summerill Tubing Company

MOLYBDENUM ALLOY

Climax Molybdenum Company

NAVIGATIONAL EQUIPMENT

Pan American Navigation Service
Simmonds Aerocessories, Inc.
Weems System of Navigation

NICKEL & NICKEL ALLOYS

International Nickel Company, Nickel Division

OXYGEN EQUIPMENT

Cambridge Instrument Company
Puritan Compressed Gas Corporation

PISTON RINGS

Thompson Products, Inc.

PLASTICS

Bakelite Corporation
Duramold Aircraft Corporation
Westinghouse Electric & Manufacturing Company

PLYWOOD

Duramold Aircraft Corporation
U.S. Plywood Corporation

PROPELLERS

Eaton Manufacturing Company
Hamilton Standard Propellers Division, United Aircraft Corporation
Lycoming Division, Aviation Manufacturing Corporation
Propeller Division, Curtiss-Wright Corporation

PROPELLER PARTS

Eaton Manufacturing Company
Hamilton Standard Propellers Division, United Aircraft Corporation
Lycoming Division, Aviation Manufacturing Corporation
Propeller Division, Curtiss-Wright Corporation
Thompson Products, Inc.

PROPELLER PRODUCTION MACHINERY

Engineering and Research Corporation

PUMPS (AIR, FUEL, OIL, VACUUM, HYDRAULIC)

Eclipse Aviation Division, Bendix Aviation Corporation
Candler-Hill Corporation
Pump Engineering Service Corporation
Thompson Products, Inc.

RADIOS (AIRCRAFT & AIRPORT)

Aircraft Radio Corporation
Bendix Radio Corporation
RCA Manufacturing Company
Sperry Gyroscope Company
Westinghouse Electric and Manufacturing Company

REMOTE CONTROL & RECORDING DEVICES

Eclipse Aviation Division, Bendix Aviation Corporation
Impact Register Company
Simmonds Aerocessories, Inc.
Westinghouse Electric and Manufacturing Company

RIVETS

Aluminum Company of America
The B. F. Goodrich Company

RUBBER PRODUCTS

General Tire & Rubber Company
The B. F. Goodrich Company
Goodyear Tire & Rubber Company

SCREWS, NUTS & BOLTS

Boots Aircraft Nut Corporation
Continental Screw Company
Eaton Manufacturing Company
Elastic Stop Nut Corporation
Thompson Products, Inc.
Tinnerman Products, Inc.

SEATS (PILOT)

Bendix Products Division, Bendix Aviation Corporation
Edward G. Budd Manufacturing Company
The B. F. Goodrich Company

SPARK PLUGS

The BG Corporation
Scintilla Magneto Company
Simmonds Aerocessories, Inc.

UNEXCELLED IN QUALITY AND DEPENDABILITY

S. S. WHITE FLEXIBLE SHAFTS for AIRCRAFT

A glance down the list at the left makes clear that the duties performed by flexible shafts in aircraft are mighty responsible ones. *Quality* and *dependability* in these shafts is therefore a first-line requirement.

Extensive use through the years in both military and commercial planes—including the big airliners and clippers—has proved that S. S. White Flexible Shafts measure up to all requirements. In fact S. S. WHITE Shafts are so universally used for the aircraft applications listed that they are practically standard.

Complete combinations consisting of flexible shaft, flexible casing and end fittings, are available for these applications—many of them made to Army and Navy Specs. We'll be glad to quote on your flexible shaft requirements.

S. S. WHITE SHAFTS ARE UNIVERSALLY USED IN AIRCRAFT

For REMOTE CONTROL of
- Radio Transmitters
- Radio Receivers
- Beacon Receivers
- Compass Loops
- Antenna Loops
- Antenna Reels
- Heating Registers
- Tab Controls
- Turn Bank Indicators

For DRIVING
- Engine Tachometers
- Tachometer Generators
- Fuel Pumps
- Controllable Pitch Propeller Governors
- Ammunition Rounds Counters
- Windshield Wipers
- Cowl Flap Mechanisms

SEND FOR BULLETIN 839

In this bulletin you will find details of many of the S. S. WHITE Flexible Shaft Combinations for Aircraft uses. A copy will be sent you on request. Write for it today.

ENGINEERING COOPERATION always available for working out specific applications. Send details.

S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

Department G, 10 East 40th St., New York, N. Y.

PACIFIC COAST REPRESENTATIVE

PACIFIC SCIENTIFIC COMPANY • Los Angeles • San Francisco

FLEXIBLE SHAFTS for POWER DRIVES, REMOTE CONTROL and COUPLING

B★A★30

REG. TRADE MARK

B ★ A ★ 30 airplane wing cloth, famous for its uniformity, is lighter, stronger and more closely woven than other airfoil fabrics.

•

WELLINGTON SEARS COMPANY

65 WORTH STREET NEW YORK CITY

USAIG

United States Aircraft Insurance Group

THE SYMBOL OF

COMPLETE AVIATION

INSURANCE

SINCE

1928

UNITED STATES AVIATION UNDERWRITERS

INCORPORATED

Aviation Managers for the

UNITED STATES AIRCRAFT INSURANCE GROUP

NEW YORK, N. Y.
80 John Street

LOS ANGELES, CALIF.
724 S. Spring Street

WASHINGTON, D. C.
Investment Bldg.

CHICAGO, ILL.
175 W. Jackson Blvd.

STAINLESS STEEL

American Rolling Mill Company
Edward G. Budd Manufacturing Company
Summerill Tubing Company

STAMPINGS (METAL)

Edward G. Budd Manufacturing Company
Eaton Manufacturing Company

STANDARD PRECISION WEIGHTS & MEASURES

W. & L. E. Gurley

STARTERS

Breeze Corporations
Eclipse Aviation Division, Bendix Aviation Corporation

STRUTS & SHOCK CORD

Bendix Products Division, Bendix Aviation Corporation
Cleveland Pneumatic Tool Company

SURVEYS (AERIAL)

Fairchild Aerial Surveys, Inc.

SURFACES (WING & CONTROL)

Edward G. Budd Manufacturing Company
Fleetwings, Inc.
Goodyear Aircraft Corporation

SWITCHES

Eclipse Aviation Division, Bendix Aviation Corporation
Westinghouse Electric and Manufacturing Company

TACHOMETERS

Breeze Corporations
Kollsman Instrument Division, Square D Company
Weston Electrical Instrument Company

TIE RODS

Breeze Corporations
Edward G. Budd Manufacturing Company
Thompson Products, Inc.

TIRES & TUBES

General Tire & Rubber Company
The B. F. Goodrich Company
Goodyear Tire & Rubber Company

TOOLS

Cleveland Pneumatic Tool Company
Paramount Products, Inc.

TUBING (FLEXIBLE)

Breeze Corporations
Eclipse Aviation Division, Bendix Aviation Corporation

TUBING (RIGID NON-FERROUS)

Aluminum Company of America

TUBING (RUBBER)

General Tire & Rubber Company
The B. F. Goodrich Company

TUBING (STAINLESS STEEL)

Summerill Tubing Company

TUBING (STREAMLINE)

Summerill Tubing Company

VACUUM SYSTEMS

Simmonds Aerocessories, Inc.

VALVES & ACCESSORIES

Cleveland Pneumatic Tool Company
Eaton Manufacturing Company
Pump Engineering Service Corporation
Simmonds Aerocessories, Inc.
Thompson Products, Inc.
Westinghouse Electric and Manufacturing Company

WHEELS & BRAKES

Bendix Products Division, Bendix Aviation Corporation
General Tire & Rubber Company
The B. F. Goodrich Company
Goodyear Tire & Rubber Company
Simmonds Aerocessories, Inc.

The Technical Information Service
of the
Institute of the Aeronautical Sciences

This service has experienced personnel under the supervision of trained aeronautical engineers to compile any information desired. The services range from listing specialized reference books to the preparation of exhaustive bibliographies, digesting of reports and general surveys of any aeronautical subject.

Some of the available services are:

Bibliographies on any aeronautical subject.

Reports on any aeronautical subject.

Digests of aeronautical books, papers, periodicals and references.

Translations in all languages.

Engineering investigations of special aeronautical subjects.

Biographies of individuals engaged in aeronautics.

Photostats of any aeronautical or general engineering material.

Microfilms made on special order.

Photographs made from the Institute's photographic collection.

Drawings and tracings made.

In addition to the services mentioned any commission which comes within the scope of the Service will be accepted.

Research work is charged at the usual library fee of $2.00 per hour. Special arrangements may be made for work requiring several weeks or months.

Translators are available for accurate transcriptions of all foreign language data. Translations are carefully edited by trained engineers at the standard rate of 1¢ per word. Minimum charge, $2.00.

Reproductions of any material in the Aeronautical Archives of the Institute may be ordered at standard photostat rates.

6

jobs where airplane and accessory manufacturers can

SAVE TIME

by using dependable, safe Oakite Cleaning for:

1. Safely cleaning aluminum or aluminum alloy structures and assemblies before anodizing or other protective surface treatment.
2. Removing excess flux from soldered aluminum and copper parts.
3. Safely preparing aluminum alloy surfaces for resistance spot-welding.
4. Speedily removing protective oil coating from aluminum sheets and plates before various fabricating operations.
5. Safely cleaning heat treated aluminum parts.
6. Cleaning planes after test flights.

In aircraft plants the Nation over, certain newly developed Oakite materials and methods are so successfully helping to SAVE TIME . . . to SPEED-UP production and INCREASE output . . . on these 6 jobs, that it will pay you to explore the possibilities they hold for you! Let us tell you more about these dependable materials, and in addition, make exacting comparative tests . . . under your own conditions . . . to conclusively prove they will meet your requirements for safety, speed, thoroughness and economy.

NATION-WIDE SERVICE FREE

Through our Nation-Wide Staff of Service Representatives you obtain the FREE services of men with a highly specialized knowledge of production cleaning and whose recommendations are backed by a binding GUARANTEE that fully protects your interests. Your inquiries invited . . . no obligation.

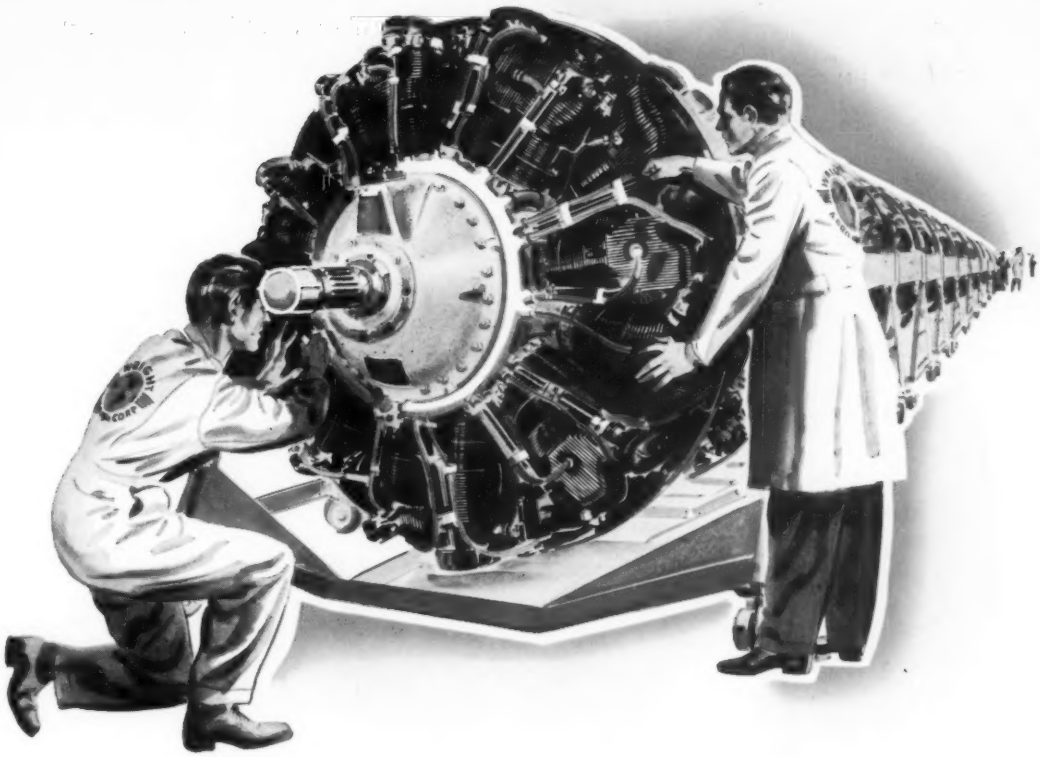
OAKITE PRODUCTS, INC., 27 THAMES STREET, NEW YORK, N. Y.
Representatives in All Principal Cities of the U. S. and Canada

OAKITE CERTIFIED CLEANING
MATERIALS METHODS SERVICE

INDEX TO ADVERTISERS

Aero Publishers, Inc. 32
Aircraft Publications 50
Bendix Products Division, Bendix Aviation Corporation . . . . . Back Cover
BG Corporation, The 52
Boots Aircraft Nut Corp. 58
Continental Screw Co. 2
Douglas Aircraft Co. Inc. 54
Edo Aircraft Corporation 58
Funk and Wagnalls Company 34
Goodyear Tire and Rubber Company, The 1
Norman W. Henley Publishing Company, The 32
Kollsman Instrument Division, Square D Company 56
Glenn L. Martin Company, The 46
Oakite Products, Inc. 64
Pan American Navigation Service 34
Paramount Products Co. 60
Shell Oil Company, Inc. 60
Sperry Gyroscope Company, Inc. 48
Square D Company, The 56
Tinnerman Products, Inc. . . . . Inside Front Cover
United States Aviation Underwriters, Inc. 62
Wellington Sears & Company 62
S. S. White Dental Mfg. Co., The 62
Wittek Mfg. Co. 58
Wright Aeronautical Corporation . . . . . Inside Back Cover

WRIGHT CINCINNATI DIVISION



Cyclone 14's ROLL OFF THE LINE

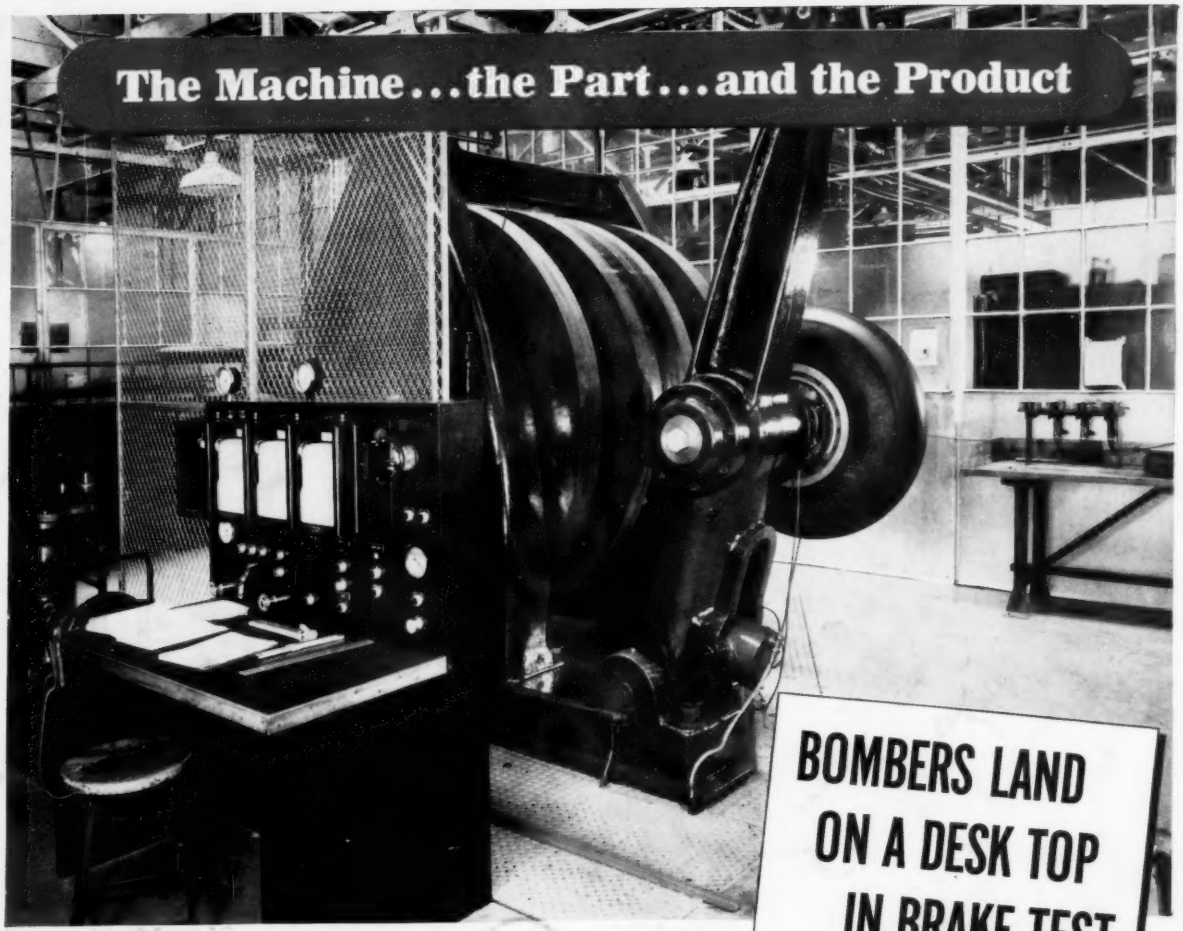
ONE YEAR AFTER INCEPTION OF WRIGHT PLAN

JUST A YEAR after the approval of the original proposal by the Defense Commission, Cyclone 14's are rolling off the line at the Wright Cincinnati Plant. Presented to the Government in June, 1940, this proposal led the way for the thousands of contracts which followed and "The Wright Plan", developed by Wright and Government officials, became the model after which these contracts were patterned.

The 2,120,000 sq. ft. Wright Cincinnati Plant increases Wright manufacturing area to nearly 5,000,000 sq. ft. and will provide facilities for a total output of approximately 4,000,000 horsepower per month. With an unparalleled design and manufacturing background, Wright has assumed major responsibility in power production for America's air supremacy.

WRIGHT AERONAUTICAL CORPORATION • PATERSON, NEW JERSEY

Division of Curtiss-Wright Corporation



Bendix Aircraft Brakes must prove they can "*take a beating*"

BOMBERS LAND ON A DESK TOP IN BRAKE TEST

SOUTH BEND, INDIANA — Two million, four hundred thousand foot-pounds of kinetic energy must be absorbed to stop a modern bombing plane landing at 88 miles an hour. Bendix Aircraft Brakes must do this job in 12.9 seconds on this specially-built Testing Dynamometer.

"BRINGING the landing-field into the laboratory" is a part of the job of building safe, sure and smooth Bendix Brakes for America's airplanes. This massive 60,000-pound Dynamometer, with a 37,500-pound flywheel whirled at rim-speeds that can go to 120 miles an hour, accurately simulates the energy which must be dissipated when a given airplane is landed at a given speed. Sensitive automatic instruments write the precise performance records of each brake tested. In this manner, Bendix precision manufacture safeguards those critical moments of ground-contact for men who fly. Equipment such as this—inspection and testing procedures such as these—keep Bendix Landing Gear excellent in every respect...which is why it enjoys every airman's respect.

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION • SOUTH BEND, INDIANA

Bendix

LANDING-GEAR EQUIPMENT

AIRPLANE WHEELS AND BRAKES • PNEUDRAULIC SHOCK STRUTS
SWIVELABLE AND STEERABLE TAIL-KNUCKLES • PILOT SEATS